THE FIRST TWENTY YEARS

The First Twenty Years

The

First Twenty Years

A History of the Growth and Development of
The American Rolling Mill Company,
Middletown, Ohio, Beginning 1901
and Ending 1922

The American Rolling Mill Company
Middletown, Ohio

Contents

The First Twenty Years

Special Frontispiece
"ARMCO SPIRIT"

Contents—*Continued*

Contents—*Continued*

Contents—*Continued*

Armco Spirit

is, in fact, simply an exemplification of the highest standard of real American citizenship.

W O

The Noblest

WORK—honest labor—is one of the noblest things in life.

"One who can feel that he is doing his fair share of the work of the world has good reason to be happy.

"No normal man can, however, be satisfied simply to work. He wants to work to some purpose and to accomplish the largest possible result, both for himself, his associates, and his company. He wants to work effectively.

"There can be no real effective work without the inspiration of that thing called 'spirit', which is the mainspring of accomplishment.

"It is for that reason that we have been so greatly interested in the development of real 'Armco Spirit'.

ARMCO spirit can first be compared with what, at school, is termed 'college spirit' or 'class spirit' as applied to those graduating in any given year. It compares with 'community spirit', or what might be described as 'group spirit' as representing the combined interest and purpose of any given number of persons working together in a common cause.

"Spirit is that thing which grips and holds the hearts of men and gives the power of extraordinary accomplishment, when working for a worthy purpose.

"Armco spirit is a comprehensive, vital force, which finds expression in the practical application of policies builded on a platform of Christian principles, in which selfish purpose has no place.

R K

Thing in Life

ARMCO spirit combines in proper proportion a spirit of fairness, a square deal always, both in theory and practice; a big, broad view of every problem, cutting out all narrowness and littleness; a spirit of unselfishness, of loyalty, of courtesy to and consideration for the other fellow.

"Armco spirit is, in fact, simply an exemplification of the highest standard of real American citizenship.

"Armco spirit is all that and more; it is that spirit which is life itself. It is a distinct, vital, concrete force. It despises class distinction; it hates inferiority in men or in products, and in all things affecting life itself. It will have naught to do with commonplace things, and glories only in the highest and the best.

IT is that intangible but intensely vital thing which so firmly grips the hearts of men that it inspires them with the inconquerable will to be and to do the limit of their endurance and ability.

"It is that latent power upon which the thoroughbred draws when, after running neck and neck with his adversary clear up to the home stretch, he suddenly forges ahead to Victory.

"It is that spirit which makes for the real brotherhood of man and the building of the highest type of Christian citizenship, which will in turn produce an indestructible democracy."

Geo. M. Verity.

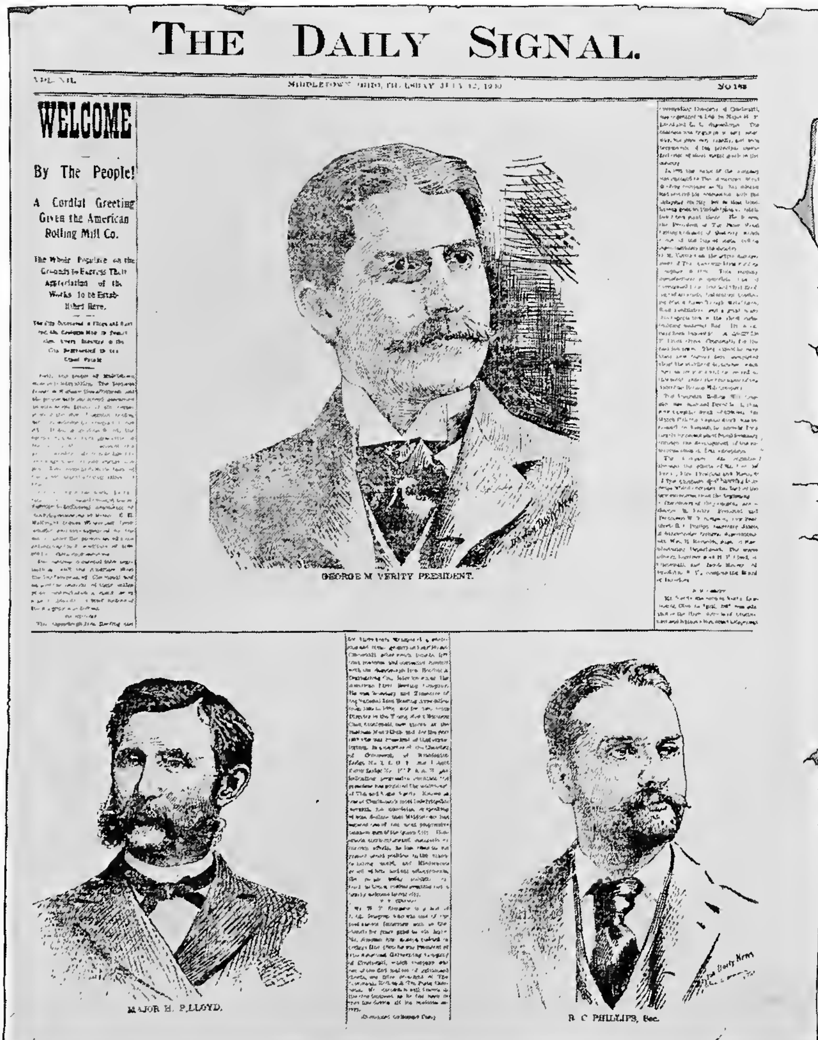
President.

Work thou for pleasure: paint or
sing or carve
The thing thou lovest, though the
body starve,
Who works for glory misses oft
the goal:
Who works for money coins his
very soul.
Work for the work's sake then,
and it may be
That these things shall be added
unto thee.

KENYON COX

Introduction

A writer of small town stories twenty years ago could have found good material had he by chance visited Middletown, Ohio. On July 12th, 1900, to be exact, the corner stone of the original works of The American Rolling Mill Company was laid. It was a gala occasion. The whole town turned out, the schools were dismissed, the national


THE DAILY SIGNAL.

WELCOME

By The People!

A Cordial Greeting Given the American Rolling Mill Co.

GEORGE M. VERITY PRESIDENT.

MAJOR H. P. LLOYD.

R. C. PHILLIPS, Sec.

Daily Signal's Welcome to Armco

Celebration at Doty's Woods, Across the Road from the New Armco Plant where the Middletown Ice Company Now Stands at Curtis Avenue and C. L. N. R. R.

guard proudly marched down the street, leading the parade, and the horses and carriages of the populace were festooned and decorated as for a carnival. In this, Middletown was no different from thousands of other small American localities that have experienced the same thrill, thousands of other hopeful communities that have given themselves over to such jollifications, as they joined together to hear the future prosperity of the city read as by a prophet of old.

Not all of these thousands of cities have been so fortunate as Middletown—not all their enthusiastic prophecies have come true. The greatness and prosperity of the community has sometimes failed to materialize.

And yet, the dreams of Middletown's appointed prophets on the day of the dedication of The American Rolling Mill Company have not only been fulfilled but very largely exceeded.

In the light of the present day facts and happenings (December 1921) the following report in the Daily Signal of June 1, 1900, is very interesting. The entire paper with flaming headlines was given over to the event.

WELCOME BY THE PEOPLE!

A CORDIAL GREETING GIVEN THE AMERICAN ROLLING MILL CO.

The Whole Populace on the Grounds to Express Their Appreciation of the Works to be Established Here.

The City Decorated in Flags and Bunting, the Business Men in Procession, Every Industry in the City Represented in the Grand Parade.

"Today the people of Middletown were in holiday attire. The business houses were closed this afternoon and the people with one accord assembled to witness the laying of the corner stone of the new American Rolling Mill and to welcome the company to our city. It was a glorious event, the opening of a new era of prosperity for this city in the establishment of a great industry, which is destined to renew again our old time energy and place Middletown high in the ranks of the great manufacturing cities of Ohio.

"The securing of the works for this city was accomplished through the efforts of the Middletown Industrial Commit-

Major Lloyd, Mr. Verity, Mr. Phillips and a group of Friends from Cincinnati at the Corner Stone Laying

tee consisting of Messrs. E. H. McKnight, Robert Wilson, and Jacob Schaffer, who were appointed by the mayor, under the provisions of a law authorizing the expenditure of $100,000.00 for certain improvements.

"The commission entered into negotiations with the American Steel Roofing Company, of Cincinnati, and secured the removal of their entire plant, constructed on a much larger scale, to this city. A brief history of the company is as follows:

"The Sagendorph Iron Roofing and Corrugating Company, of Cincinnati, was organized in 1883 by Major H. P. Lloyd and L. L. Sagendorph. The business was begun in a very small way, but it grew very rapidly, and soon became one of the principal manufactories of sheet metal goods in the country.

"In 1891 the name of the company was changed to the American Steel Roofing Company as Mr. Sagendorph had severed his connection with the company shortly before that time, having gone to Philadelphia to establish a new plant there.

"Mr. G. M. Verity took the active management of The American Steel Roofing Company in 1889. This company manufactures a complete line of corrugated iron, iron and steel roofings of all kinds, galvanized conductor pipe and eaves trough, metal lath, roof ventilators, and a great many other specialties in the sheet metal building material line. Its works have been located at 226-228-230 E. Front Street, Cincinnati, for the past ten years.

They expect to have their new factory here completed about the middle of September, when their entire works will be moved to this point under the firm name of The American Rolling Mill Company.

"The American Rolling Mill Company was organized December 2, 1899, with a capital stock of $200,000.00. On March 17 the capital stock was increased to $500,000.00 to provide for changes, and improvements in the Company's original plans.

"The company was organized through the efforts of Mr. Geo. M. Verity, vice-president and manager of The American Steel Roofing Company, which company has backed the new enterprise from the beginning.

"The officers of the company are: George M. Verity, president and treasurer; W. T. Simpson, vice-president; R. C. Phillips, secretary; James B. Strawbridge, general superintendent; William M. Reynolds, supt. of manufacturing department. The above officers, together with H. P. Lloyd, of Cincinnati, and Jacob Maurer, of Brooklyn, N. Y., compose the board of directors.

"The exercises commenced this afternoon with the assembling of the people at the City Building. The whole population formed in line and led by Harry Wilson repaired, with drums beating and colors flying, to Doty's Grove, adjoining the site of the big factory where the Mayor acted as master of ceremonies.

Curtis Avenue then was Only a Country Road

"The invocation was offered by Rufus W. Weaver, D. D., pastor of the First Baptist Church.

"W. S. Harlan, Esq., the City Solicitor, offered the welcome address on the part of the people of Middletown. He spoke as follows:

" 'I am happy to voice the sentiments of this assemblage, when I state that we all esteem it a pleasure and a privilege to be present at these ceremonies that bear so much importance to the future of the city of Middletown.

" 'We have not met to garland the triumphant march of a returning hero, we have not met to signalize any victory of American arms, but our mission today has to do with the gentle walks of peace, and concerns the industry and material development of our people.

" ' "Peace hath her victories no less renowed than war," and so we have met to lay the corner stone of the building of a mighty enterprise that will bring employment, and with it prosperity, happiness and contentment to hundreds of our citizens, and to extend a welcome to the gentlemen of The American Rolling Mill Company, whom we thank for locating here.

" 'I may say that in another sense we have met to pay tribute to those traits of character that have made this country great, that have placed it in the very vanguard of the nations of the earth, namely, American energy and American courage.

" 'It was that same energy and courage that enabled our forefathers to settle in the New World, to contend with wild beasts and wild men, to clear the forests, to till the soil, and to build churches and school houses.

" 'It was that same energy and courage that even now is contemplating the construction of the great Nicaraguan Canal, lines of submarine cables, and all great movements that make for the betterment and uplifting of the human family.

" 'We have a local pride in the city of Middletown. We are proud of the public spirit and patriotism of her people. She has ever hearkened to her country's call. Two years ago, when the call to arms came, Middletown was among the first to send forth her quota of brave boys.

" 'We are proud of the position she has held from an early day as a center of trade and manufacture.

The First Temporary Office Building of Armco Used During the Construction of the Works

" 'The fame of her great factories has spread beyond the confines of her own land. Her tobacco, her paper, her bicycles, her agricultural implements, and other manufactured articles, have gone forth and been recognized in all the marts of the world.

" 'We are proud of this accession to her manufactories. The enlarged use of iron is one of the prominent characteristics of our age, each day witnessing some new application of it in the arts of life.

" 'We gladly welcome new industries. When it comes to establishing new enterprises, our people believe in but one policy, that of the "open door."

" 'Gentlemen of The American Rolling Mill Company, you have won our profound respect and admiration by embarking in this great enterprise in our midst, by constructing this plant of such mammoth proportions and by doing so in such an expensive and durable manner.

" 'You have demonstrated that you have the fullest confidence in yourselves, in our city, and in the future. We extend to you a most cordial greeting and welcome. May your success be as substantial and durable as the splendid structure you are building. May there ever exist harmony between employer and employee. May your business be profitable to you, and a blessing to this community.

" 'My friends, we trust and believe this marks an epoch in the history of our city, that the laying of this corner stone of this new industry, at the dawn of the century, under such auspicious circumstances may be the beginning of a new era of renewed and greater prosperity, and that our city will enter upon a larger and wider field of activity and industry than she has ever enjoyed.'

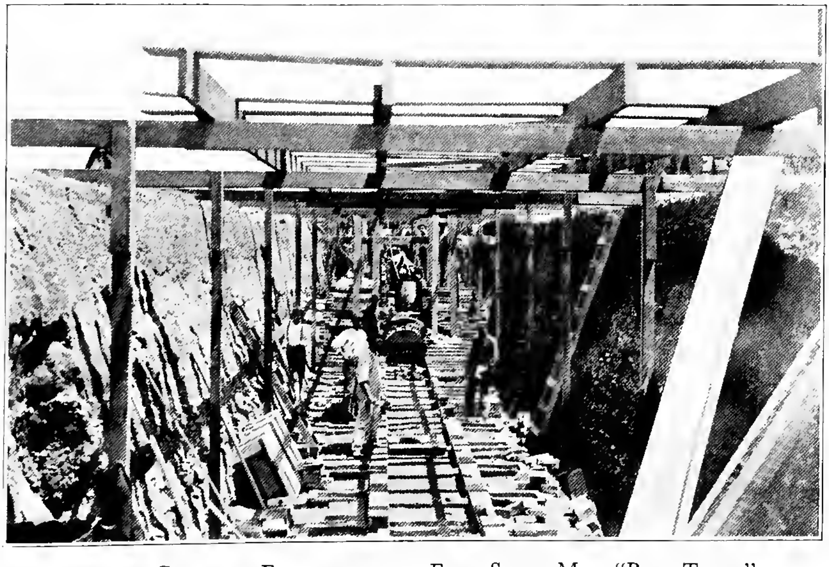
"Geo. M. Verity, in a happy strain, responded on behalf of The American Rolling Mill Company, He said:—

" 'We have received many cordial welcomes from individuals during the past few months, all of which have been greatly appreciated by us, but that we should receive such a magnificent welcome as you have accorded us today is beyond all expectations and will be appreciated by every member of our company. We feel the weight and sincerity of your good will most deeply, and it proves to us that the people of Middletown can not be excelled for cordiality and hospitality.

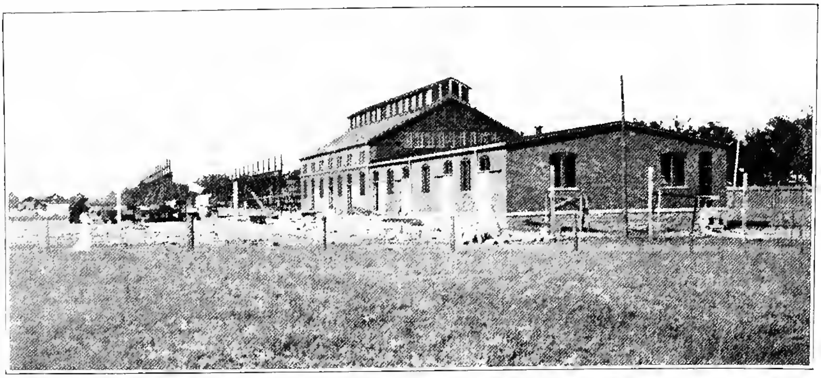
" 'In return, on behalf of our Board of Directors, I wish to welcome you one and all to yonder spot where our works are in process of construction. The location is in itself historic, having been acquired from the government by Daniel Doty and settled upon by him almost a century ago. Mrs. Catherine Doty, who represents only the second generation, is still living in the old homestead. We hope that with your assistance we can make it famous as the location of the first steel plant and sheet mills in this broad valley, and that for you it will prove a start in the right direction; that not only other iron industries may follow our example in locating here, but that you may secure many others of various kinds, which will result in more than doubling the population of Middletown by the time we reach 1910.

" 'No more beautiful valley can be found on the face of this broad earth than that of the Big Miami from Dayton south. It is already the home of many industries, and the next ten years should see many, many more in successful operation; and you must see to it that your city gets her full share of the increase that is bound to come.

" 'The struggle for commercial supremacy in this era of expansion, progression, and consolidation, between nations, states, cities, corporations, and individuals becomes greater every day, and only those can hope to win who are



Laying Concrete Foundation for First Sheet Mill "Roll Train"



Central Works Under Construction

awake, energetic, and progressive, and who keep continuously at work.

" 'For these reasons our old company, still located in Cincinnati, deemed it advisable to branch out into this new business at Middletown, where it could control the manufacture of its own raw material; and for the same reasons we have made several important additions to our enterprise as originally planned, it being our aim to strengthen ourselves in every possible way by incorporating all the known modern improvements and ideas in the manufacture of steel and steel sheets, and sheet steel building material.

" 'When our plant is completed, your city can boast of having the most modern and complete works of the kind in the United States.

" 'It was no small sacrifice for us to decide to bring our manufacturing business from Cincinnati, as it has been established there for more than sixteen years; but we could not give both the new business here and the old one there the close attention which each demanded. And so through the assistance of your Industrial Commission we effected the necessary arrangements for the transfer, and will have all our business interests in Middletown. Now that we are to become one of you, the best interests of your city will be our best interests, and we will do all in our power to make Middletown known to all the world as a manufacturing center.

" 'We wish to take this opportunity to thank the members of your Industrial Commission for the great courtesy and consideration they have always shown us. While they have looked strictly after the interests of your city, they have at all times been eminently fair to us, and have

been ever ready and willing to assist us in working out any problem that had to be solved. They did everything they could consistently to secure this enterprise for your city, and all our dealings with them have been of the most pleasant character.

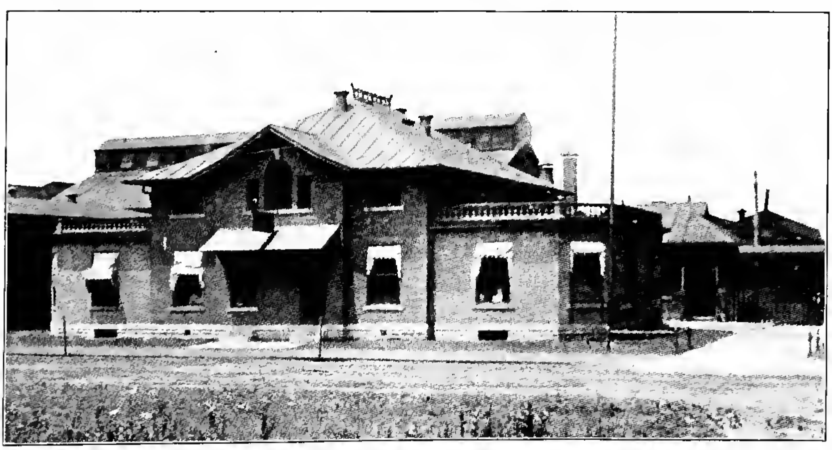
" 'You certainly do not know and cannot realize the amount of hard work they have had to do in connection with securing a suitable site and perfecting all details. They certainly deserve the warmest thanks of every citizen of Middletown for their unselfish and efficient work.

" 'In conclusion we wish to offer you a cordial invitation to visit us in the days to come, when our plant will be completed and in operation.

" 'We will at all times take great pleasure and special pains in showing our Middletown friends through the works, and we hope to see you often.'

"The assembly then adjourned to the grounds of The American Rolling Mill, where W. H. Todhunter, in a very interesting speech, gave an outline of the industrial evolution of Middletown.

"Then came Major H. P. Lloyd, who in eloquent speech gave the multitude a history of The American Rolling Mill Company. The list of articles to be placed in the box in the corner stone of the structure, was then read by W. K. Rhonemus, the Mayor laying the stone. The meeting closed with an address from Benj. Harwitz and the raising of the American flag."



Main Office Building 1907

Thus did the newspapers record the birth of Armco. Twenty years is a short time in the annals of history and yet how far back it seems, revealed in the cold type of newspaper files. Yet in that brief space of time Armco has grown from an infant in swaddling clothes to a great institution. The story of its growth is a story of grit, determination, stick-to-it-iveness, and faith in fundamental principles.

No one thing could have accomplished so much. The building of Armco has required the combination of brains and genius on the part of executives, backed by many loyal workers in the plant, each giving that full measure of strength and devotion which together made up an invincible force for achievement and sound progress.

Chapter I

Past History and Accomplishments

Original Conception—First Five-Year Period—Second Five-Year Period—Third Five-Year Period—East Side Works—Acquisition of Blast Furnace and Mines—Fourth Five-Year Period—Addition to East Side Works.

THE American Rolling Mill Company began operations in Middletown in March, 1901, just about the time the United States Steel Corporation came into existence and absorbed practically all of the rolling mill companies which were then manufacturing sheet iron and steel.

Prior to that period the iron and steel business of the country was divided into a larger number of distinct branches. The sheet metal business was carried on by such manufacturing companies as The American Steel Roofing Company of Cincinnati, whose business was absorbed by this company in 1900, and The Cincinnati Corrugating Company, owned by J. G. Battelle, J. H. Frantz and others, later owners of The Columbus Iron & Steel Company.

At that time sheet iron and sheet steel were manufactured largely by rolling mills who purchased their raw materials in the shape of billets or sheet bars from larger steel works, who in turn procured their raw material in the shape of pig iron from blast furnace companies.

The galvanizing of sheet metal, making the product known commercially as "galvanized iron," was carried on by such companies as The American Galvanizing Works which was operated on Pearl Street, Cincinnati, Ohio, and owned by William T. Simpson, who later became First Vice President of Armco. This was at that time a distinct branch of the metal business.

The American Rolling Mill Company was one of the first to bring together all of these various branches of the industry, with the single exception of the blast furnace.

The original conception including an open hearth furnace department which manufactured steel ingots; a bar mill department which reduced those ingots to billets

The First Spadeful of Dirt in the Construction of the East Side Works, March 1910

or sheet bars; a sheet mill department which converted the sheet bars into sheets ready for the market as black iron or steel sheets; a galvanizing department which coated a certain percentage of the black sheets, making galvanized iron and steel; and a factory department where both black and galvanized sheets were used in the fabrication of sheet metal building materials of all kinds. This brought together into one harmonious whole what had formerly covered four distinct lines of manufacture.

The strength of this first conception lay not only in bringing together these various processes with the resultant economy of operation, but in the ability to use the open hearth furnace in the making of special and difficult grades of steel not readily obtainable on the market.

The *first five-year* period of operation in Middletown was absorbed in working out the problems incidental to an amalgamation of the processes heretofore described; in acquiring the necessary experience in the manufacture of special grades of steel and iron, and in rolling and fabricating them; in developing an organization; and in acquiring all of the basic experience needed in the conduct of the business. The company had also to develop its small steel works to a point where it could not only make the quality of product desired, but could secure a fair cost of production that would insure a reasonable profit on finished products.

The first installation included only one twenty-five-ton open hearth furnace. Sales at the end of the first fiscal year amounted to $281,181.12. At the end of five years the company had two fifty-ton open hearth furnaces which were able to produce more raw steel for sheet bars than the finishing department, as then developed, could finish. Approximately seven hundred men were employed, and annual sales had reached a little more than one million dollars.

At the beginning of the *second five-year* period there was a surplus of steel from the open hearth department, and the business had developed to a point where it demanded more tonnage of finished products than the plant could make. To solve that problem quickly without further delay in creation of organization and expense in development work The American Rolling Mill Company purchased the sheet mills and factory of The Muskingum Valley Steel Company of Zanesville, Ohio, a going concern with an

The Site of the East Side Sheet Mill Building

established working organization, and paid for this property in stock of the company.

This immediately gave Armco more than double the tonnage of finished sheets it formerly had available for sale, and made it possible for the company to take care of its growing trade and to greatly reduce its general overhead with a resultant increase in profit.

At the end of the second five-year period the company had three fifty-ton open hearth furnaces, and was producing approximately forty-five hundred tons per month of black and galvanized sheets in the Middletown and Zanesville mills, as compared with nine hundred tons a month during its first year. The number of employees had increased to fifteen hundred, and annual sales to over $3,600,000.00.

At the beginning of the third five-year period the sales department was again making demands for more tonnage to supply the growing number of valued customers. These demands were so insistent that further manufacturing development was given serious consideration. The first thought was to increase the capacity of the original plant, now known as Central Works, by a duplication of departments then in existence; but mature consideration made it clear that this would be a very short-sighted policy.

The plant at that time operated under what is known as "small mill practice," and produced in the open hearth department small ingots measuring eight by eight inches, by four feet long. These ingots were broken down into billets

or sheet bars on a small two- and three-high bar mill. This practice was necessary where the annual tonnage of ingots produced in the open hearth department was less than one hundred thousand tons. Careful investigation made it clear to the management and to the directors that if they were going to provide for a business of more than one hundred thousand tons per annum, that the company would have to adopt "big mill practice" which would enable it to produce ingots and sheet bars at a very greatly reduced cost.

The decision resulted in the planning and building of the Company's large modern plant known as "The East Side Works."

This new plant consists of:

A unit of four, seventy-five-ton open hearth furnaces, with equipment that would produce ingots six feet long and twenty-four by thirty inches at the base, instead of four feet long and eight inches square, as formerly;

Soaking pits for the complete re-heating of ingots taken from the open hearth department;

A forty inch blooming mill (the largest in use in standard steel works) capable of reducing the large ingots made in the open hearth department to billets or slabs at a minimum cost of production;

Making the First Charge at the East Side Open Hearth

A modern bar mill to reduce the billets made in the blooming mill department to sheet bars under the most approved methods;

A large central power station, where the waste steam from the large engines necessary to operate the blooming and bar mills could be used in turbo-generator units to produce electric current at a minimum cost and in sufficient quantity to supply power for the sheet mill department, for cranes, for lighting the plant, and for all similar purposes;

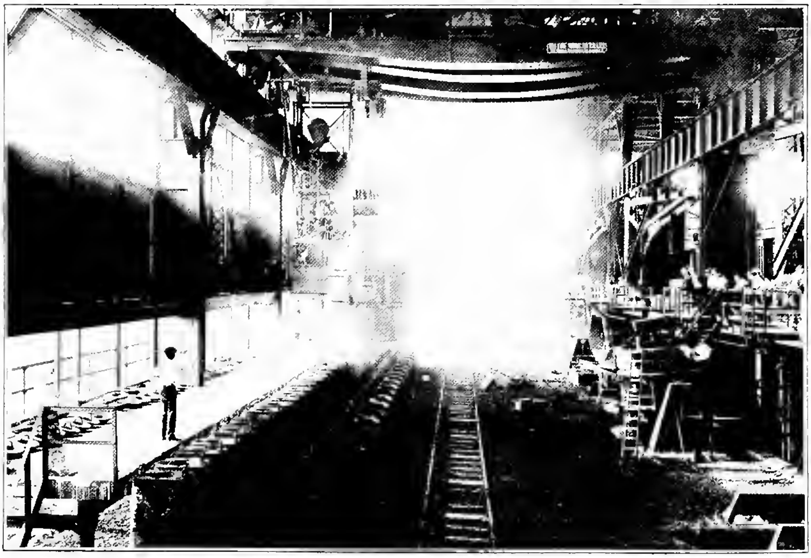
Large maintenance shops;

A sheet and jobbing mill department; and

A finishing department capable of taking the black sheets from the sheet mills and converting them into galvanized sheets, alloy coated sheets, or high polished sheets for the use of automobile, stove, metal furniture, and other manufacturers.

Ground was broken in March, 1910, for the East Side Works, and operations were commenced in September, 1911.

The ten-month period from September, 1911, to June 30, 1912, was consumed in getting the big mill into successful and practical operation. In spite of the fact that this had to be done at a time when both demand and market prices were very unsatisfactory, the new plant was in successful operation at the close of that fiscal year which ended in June 1912.



Pouring the First Heat at the East Side Works

In the construction of the new works the company's engineering department, which had been established in 1900, worked in connection with the drafting forces of the Consulting Engineer who had been employed to design the new works.

On the completion of the East Side Works all the work of an engineering character was definitely centralized in a single department in the new plant. From the lone draftsman who had first been employed, the engineering department grew during this period into a well organized force capable of designing and supervising any construction work needed by the company.

Making the Fields Bloom with Industry

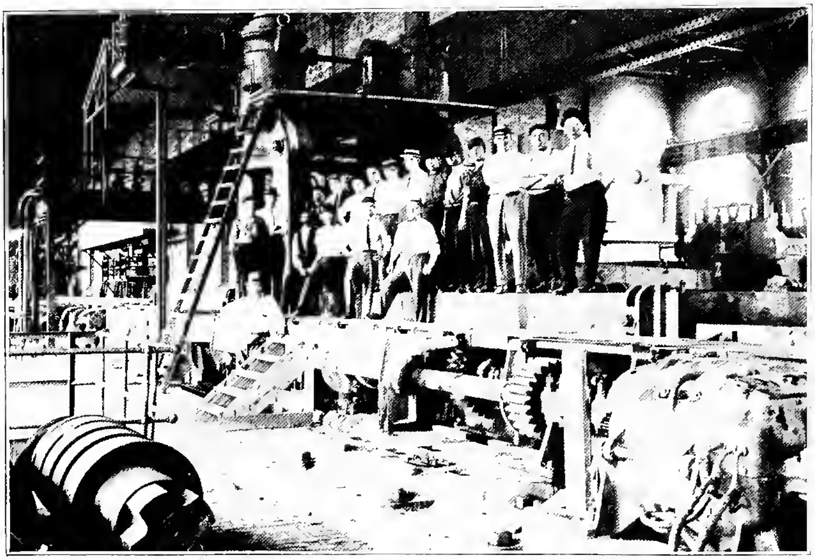
The engineering department has on file in fireproof vaults approximately forty thousand blue prints of the plant and equipment. Armco's plant development from 1911 to 1920 shows construction work valued at more than ten million dollars which was planned by its own engineering department. Shown by years, it is as follows:

1911	$ 17,518.73
1912	86,535.65
1913	328,314.57
1914	4,277.77
1915	217,707.97
1916	2,261.326.22
1917	1,265,143.46
1918	95,962.20

1919	851,389.61
1920	5,240,871.61
Total	$10,369,047.79

With the advent of the World War there was built and put into operation, in the shortest possible time, a forge shop capable of making shell forgings from five inches to nine inches in diameter; and at the end of the third five-year period the company was employing forty-five hundred men, and its annual sales were $13,262,835.32.

The fourth five-year period began under very auspicious conditions. The company's manufacturing methods had been so greatly improved and the production capacity



READY TO ROLL THE FIRST INGOT AT EAST SIDE WORKS

of all finishing departments so largely increased that the board of directors found it necessary to authorize a substantial addition to the open hearth furnace department, in order to avoid the necessity of purchasing in the open market further supplies of billets and sheet bars.

Four new open hearth furnaces, each with a minimum capacity of one hundred tons, were built, giving one hundred and twenty-five thousand additional tons of billets yearly for use in the various finishing departments.

The company as then organized produced everything it consumed in the manufacture of its products except

pig iron which had always been purchased in the open market on very satisfactory terms.

At a meeting of the board of directors the question of a future supply of pig iron was considered. The trend of the market was such that it seemed very certain the company would have to pay an exorbitant price for pig iron for the next year, and possibly for an indefinite period. A committee was appointed to investigate the possibility and advisability of taking over a going blast furnace property.

The investigation of this special committee resulted in an agreement with The Columbus Iron & Steel Company, from whom the company had purchased a large percentage of its pig iron for many years, covering the conditions under which a merger of the two companies could be accomplished. This was effected on the basis of their accepting securities of The American Rolling Mill Company in exchange for their entire properties at an agreed valuation.

The Columbus Iron & Steel Company obtained its iron from its own mines in West Virginia; its coke from its by-product coke ovens at Portsmouth, Ohio; its ore from its mines in the Lake Superior District; and owned its own ore steamers on the Great Lakes. It had at Columbus, Ohio, a unit consisting of two blast furnaces which were capable of producing at least 200,000 tons of pig iron a year.

The amalgamation of these properties put Armco in an impregnable position where it was not only certain of a constant and sufficient supply of raw material, but did not have to pay a producer's profit to any one for the raw materials entering into the manufacture of Armco products. It gave Armco the benefit of producer's cost in every process from the ore to the finished product.

During this period the United States entered the great war. By that time the company was equipped with a large forge shop capable of producing shell forgings of large size, crank shafts for marine service and miscellaneous forgings. Throughout this period a determined and conscientious effort was made to supply the government with every possible pound of material that could be produced.

Immediately following the armistice, preparations and plans were made to follow the government's wishes in gradually reducing the production of war materials without great disturbances to the industry. This policy resulted

in the termination of their manufacture on December 31, 1918.

After the forge shops were discontinued a comprehensive survey of the company's activities brought out the fact that its open hearth producing capacity was in excess of its finishing capacity, and in May, 1919, the matter was carefully reviewed by the board of directors who authorized the building of eight sheet mills at the Middletown plant. In December, 1919, it was decided to build four additional mills at Zanesville so as to balance the production capacity of the Steel Works and Blooming Mill at Middletown.

At this time advantage was taken of the opportunity to entirely rearrange the processes and plan of operation of the sheet mill department at Middletown in order to insure a better and more uniform product, thus capitalizing the previous ten years of experience in the manufacture of high grade sheets.

By July, 1919, financial arrangements had been completed and contract executed for the construction of the new works. The first unit of the new mills at Middletown started operations in December, 1920, and the remainder shortly thereafter.

Early in 1919, it was decided to enlarge the blast furnace plant at Columbus so as to increase its capacity to 250,000 tons a year.

Each five-year period of Armco history has shown a marked expansion in organization and equipment. Starting with one twenty-five-ton furnace and a small finishing department the company has in twenty years acquired twelve large open hearth furnaces with finishing departments capable of caring for their entire product, and has secured its own sources of supply of raw materials.

The Company begins its fifth five-year period equipped to undertake every step in the process of manufacture from the ore to the finished product, with its various works and other departments perfectly balanced and modernly equipped, and with an organization the result of twenty years of training and cooperation in the making of products under the Armco standard of quality.

Chapter II

Development of Plant Operations

Beginning of Construction—First Furnace Design—Open Hearth Difficulties—Gas Supply—Operatives' Horseplay—Pouring of Ingots—Second Furnace Built—Installation of Labor Saving Devices—Pit Operations—Early Bar Mill Practice—Troubles of Operation—More Labor Saving Devices—No. 3 Furnace Built—Improvement in Bar Mill—No. 4 Furnace Built—Installation of Water Cooled Doors and Frames—Stripping Molds from the Ingots—Installation of Top Pour Molds—Building and Equipment of East Side Works—Improved Pouring and Stripping Practice—Training Furnace Men—Blasting the Salamander from No. 2 Furnace—Installation of Oil in Open Hearth—Flood in 1913—Raw Material Difficult to Secure Because of the War—Further enlargement of Auxiliary equipment—Cooling of furnaces—Institution of Eight-Hour Shifts—Steel Strike—Coal Strike—Outlaw Railroad Strike.

THE governing factor in locating the plant of The American Rolling Mill Company at Middletown, Ohio, was not primarily the proximity of raw materials, but rather the fact that Middletown was situated in the heart of a beautiful valley adjacent to a thriving and prosperous farming community, where living conditions could be made to respond to the highest needs of its citizens and men could be trained to believe in and carry out the ideals of the company. Armco has been noted, from its inception, for the development of new products. Not the least of these has been the upbuilding of an organization that represents quality and service in its collective effort.

In the fall of 1900, ground was broken for its first small plant, a complete manufacturing unit. Armco can boast of being the first plant in the country, in fact, in the world, to convert pig iron and scrap into manufactured building materials ready for the consumer's use, in one continuous plant and on one plot of ground. An open hearth furnace, bar mill, and sheet mills with their heating furnaces, galvanizing and factory departments were soon in the process of erection.

The first shovelful of dirt from No. 1 open hearth furnace excavation was dug September 10, 1900. This furnace was built on a solid, concrete foundation, as was common practice in those days. The charging floor was on the yard level, which necessitated a deep ladlepit. The checker chambers were built as a unit under ground to

eliminate binding, conserve heat, and save space. The furnace binding was very light, and not a permanent structure. Ladle stands were unknown as the ladle was held under the spout at tapping time by a 30-ton crane. The furnace was built for burning producer gas and had two gas ports and one air port in each end. Reversal of the gas and air was accomplished by means of Forter and Velte valves respectively, but as these were operated by hand they were very difficult to reverse.

In those days industry, as a whole, had not shown any decided effort to conserve the human element in manufacturing establishments. Lack of ventilation and comfort was very noticeable in the low-roofed open hearth melting department. Water-cooled doors and frames had not, as yet, been invented. The space provided for cleaning slag pockets and checker chambers was very inadequate, very inefficient, and so hot that they were veritable "man killers."

Labor-saving devices were very rare. As labor was plentiful and cheap almost every operation was carried on by hand. The stock was loaded, pushed into the furnace, and charged by hand, the last operation being performed with the aid of a manually operated charging peel.

When the bottom was made in No. 1 furnace, Austrian magnesite and tar were first intimately mixed, then this composition was rammed into the bottom and sides of the hearth with red hot tampers, or rammers, until the required thickness had been reached. After this step, the furnace was lighted, dried out, and heated up to full operating temperature.

In order to close all crevices some basic cinder was then melted in the hearth and thoroughly splashed over the banks. This operation being completed the remainder of the slag was tapped out and the furnace was ready for steel making.

The first heat was charged by hand on February 7, 1901, fifty thousand five hundred pounds of pig iron and scrap with 7% limestone being melted down into a merchant steel heat in twelve hours fifty minutes. The heat analyzed .040% sulphur, .065% phosphorus, .26% carbon and .74% manganese. The yield in ingots was only 57% of the charge. Three heats were made successfully.

Open hearth departments are noted for the variety and the originality of their ways for keeping themselves in the

Tapping a Heat in the Early Days

plant's eye. This new plant was no different from any other. The ladle crane broke down before the fourth heat was tapped, and the heat had to be held in the furnace twelve hours after it was ready to tap. Then as the crane still refused to work, the heat had to be poured on the ground. Meantime the entire bottom of the furnace had come up and a grand mess resulted. In order to drain out the steel and slag remaining in the furnace, a hole had to be dug more than a foot below the tap hole. In those days the use of oxygen in open hearth work was unknown so this job must have required a tremendous amount of the most severe exertion and labor.

In 1901 furnace men burnt the roof of the furnace so badly in forty heats that it fell in on a heat of steel. The bricklayers and laborers had their first taste of repairing a furnace with a hot heat in it. Eventually the furnace was completed and the metal melted out though the heat was a total loss. Not until many such events had occurred in those days did open hearth men learn how to successfully tap out such "sticker" heats.

The open hearth, bar mill, sheet mills, and annealing furnaces were all operated on producer gas. Hand-poked and hand-fed Duff stationary producers were installed west of the Central Works sheet mill proper. The steam control, unlike the present arrangement at the East Side Works, was in the gas house, and was jealously guarded by the gas foreman.

During the day when the gas foreman was on duty the volume of gas was generally sufficient for all purposes, provided the coal was of good quality. When he went home operations in the gas house slackened very noticeably. As the gas house was always full of fumes, it was only natural that the foreign gas-makers would become drowsy and sleepy as night approached. First helpers had to wake the gas makers continually in order to have enough gas to melt and tap a heat.

After a heat had been tapped and a new charge put into the furnace, tradition records the times when open hearth operatives, tired out by strenuous work, also took a nap, from the melter on down to the pullup. The superintendent on the following day would wonder why a particular heat was so far behind schedule. As a counter irritant he later "winked" at a mild form of hazing, called "bugging" which the men used to punish a sleeper.

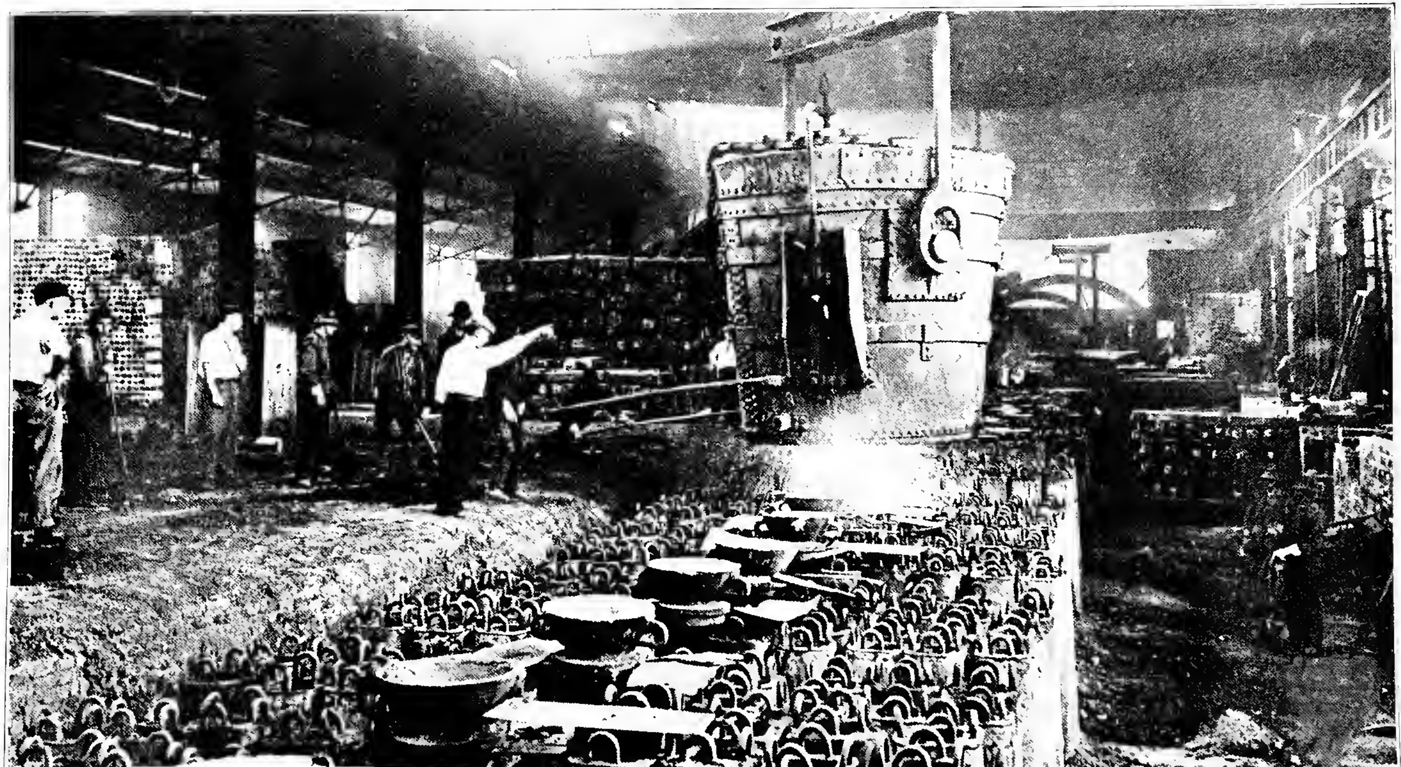
This operation consisted in wetting a piece of red hot dolomite and placing it upon the arms or legs of the slumberer. Every one immediately became very busy in some routine work. In a short time the steam would take effect, and the victim would let out an unearthly yell. He would wake up thinking he had stuck his foot or arm into a furnace. One application was usually sufficient to teach a man to keep awake. Such stunts are frowned upon in these days of "Safety First" as a man often had his leg badly blistered.

Pouring metal into the ingot molds at this time was very interesting. At first, star-shaped bottom plates were set in the pit for holding twenty molds. The steel, after it had run into the ladle, would be carried by the crane over a group of iron molds, each eight by ten inches in cross section, so placed that when the metal was poured through a central fountain, it flowed through a hollow tile runner underneath the molds and rose by gravity into all molds at one time. This style of pouring was called "bottom pour." As each ingot weighed from eight hundred to one thousand pounds, four or five groups of molds had to be poured every time a heat was tapped.

In the spring of 1902 business had progressed to such an extent that a second furnace became necessary; so No. 2 furnace with a capacity of forty tons was built. The first heat was tapped from it on July 30, 1902, with no mishaps.

At this time several labor-saving devices were installed, simplifying work and increasing tonnage. A mechanical charger replaced the hand operated peel, a fifty-ton crane was installed to pour the larger heats, and a mule (four-legged) was secured to pull the stock from the stock yard into the melting house. Old Maud soon became an institution. Eye witnesses claim that at times furnace delays were charged to her stubborn character. Fifteen minutes delay on account of a balky mule would sound odd to an open hearth furnace man today.

The pit by this time became a very important part of the department. A large crew of laborers—all foreigners except the foremen—was required to place the brick in bottom plates, set the runners, molds, and foundations, strip the molds from the ingots after a heat was poured, and transfer the ingots to the cleaning floor at the bar mill. "Safety First" was absolutely unknown. The work was



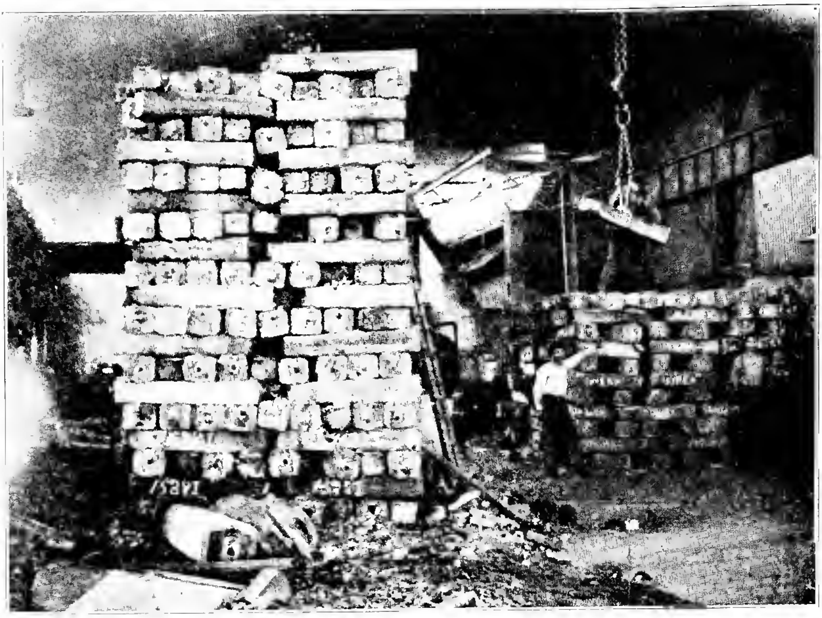
An Early Picture of Armco Operations Pouring Small Ingots

difficult and dangerous. Men had to withstand intense heat, and have great endurance. Present-day operations are child's play compared to the work done by those pitmen. Grasping in each hand a chain hanging from a crane, men had to walk on a very unsafe, narrow board across the top of red hot molds after a heat had been poured. The chains were hooked into the lug on top of the molds, and the craneman was given orders to lift the molds from the ingots. In the meantime the stripper made his way back to the bank as best he could. After all molds on the bank side of the center runner had been taken off, another man swathed in wet sacking ran between the molds on the farther side, and hooked the chains into those molds from below. After all molds were stripped, a man had to throw a chain around several red hot ingots in each group. Then the craneman would carry the entire twenty ingots to the cleaning floor. At this point the sprues or runners were knocked from the ingots after which the ingots were then ready to be charged into the bar mill furnace. These operations caused frequent burns, and several times serious accidents resulted when red hot ingots fell over on men.

When No. 1 open hearth furnace was built, a small two-and-three-high bar mill was installed, as the expense of building a large mill was prohibitive and not adapted to the method of operation. The first bar mill furnace was built on exactly the same principle as an open hearth furnace with the exception that it was controlled by large dampers so that the steel placed in it was heated only to rolling temperature instead of being melted. The bottom was flat and made of sand. The first furnace was built at right angles to the roll train, on the north side of the run-out tables.

The ingots were taken from the cleaning floor by a crane, placed on a truck, rolled in front of the furnace doors where, with large tongs handled by hand, they were charged into the furnace. The ingots were turned over and over to heat them uniformly from all sides.

As soon as the ingots had become thoroughly heated through or "soaked," they were taken out of the furnace, one at a time, and conveyed to the first pass of the roughing rolls. They were handled on the mill train by large tongs supported from an overhead trolley. The eight by ten inch ingot was then given four passes back and forth through the roughing rolls. The ingot by this



Early Picture at Central Works Showing Pile of Small Ingots

time had been reduced to a four by seven inch billet. By means of a trolley this billet was carried to the finishing rolls on the same roll train. Eight passes reduced the bar to the required thickness and a seven inch standard width. The bar, now twenty-five to sixty feet long, ran out onto a large moving train of rolls which carried it to the hot shear where the bar was cut into desired sheet-bar lengths on an endless chain conveyor. The cut bars passed through a water bosh and were then loaded by hand onto trucks for the sheet mill. This mill was a "back breaker," and only the most powerful men could do the work.

The main energies were bent in these years toward development of various products and improving furnace practice. The tonnage for the year varied from 23,000 G. T. in 1904 to 28,100 G. T. in 1908.

When the plant first started there was no fence around the property and sightseers often wandered into the open hearth department. One Sunday morning in 1903 a young man, dressed in a very light colored suit, visited the plant. He was, of course, the center of attraction for all eyes. As he paraded in the rear of the boiler house near No. 1 furnace he suddenly disappeared. Only quick action on the part of the furnace men saved the young man's life.

The main tunnel to the No. 1 furnace stack had caved in under him. However, except for a few burns and a blackened suit, he was none the worse for the experience.

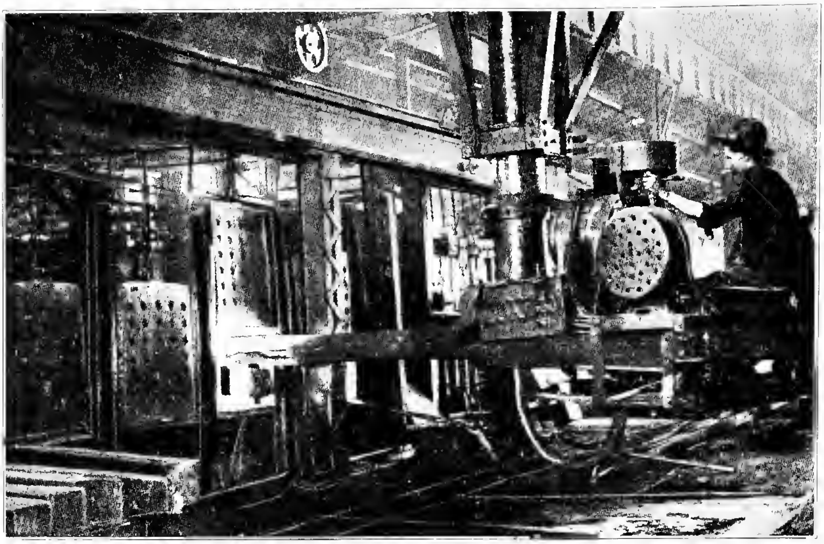
One of the greatest troubles in furnace operation was the fact that at times the tap hole froze full of steel after a heat had been tapped. This was called a "monkey." Generally twenty thousand to thirty thousand pounds of pig iron had to be melted in a furnace to clean the tap hole of this steel. When tapped out, this metal was always a total loss. At the present day, by the use of several bottles of oxygen, such a monkey is melted in half an hour.

The year 1904 was exceptional for its many diversified troubles in the open hearth department. In the last days of March, No. 2 furnace began to puff badly every time the valves were reversed. Heats began to melt very slowly. On Easter Sunday both furnaces were shut down and when they were heated up again it was found impossible to bring No. 2 furnace up to melting temperature. An examination of the tunnels disclosed 14 inches of water under the checkers and tunnels. In attempting to run the furnace, much time and steel were lost until finally the roof fell in and a bad steel break-out resulted. Part of the steel ran into the slag pockets and dynamite had to be used to clear the furnace. A concrete mat was poured on the bottoms of the tunnels and checker chambers on which were laid hollow eight-inch tiles. Two courses of brick were laid above these tiles and grouted in. Then steam syphons lowered the water sufficiently that the furnace could again make steel. The water never rose higher than 6 inches in No. 1 furnace because the checker chambers were more shallow.

A very serious fire broke out in the engine room July 30, 1904, causing so much damage that heat in No. 2 furnace was tapped into the pit to keep it from freezing in the furnace.

In January of 1907 water again began to seep into No. 2 furnace. Finally the water rose till it practically shut off the tunnels and the furnace had to be shut down. Two fifty-foot wells were sunk at No. 2 stack, and in a week's time had lowered the water level in the adjacent ground sufficiently to clear water from No. 2 chambers, and no further trouble ensued.

During the noon hour on July 10, 1906, a sudden storm tore down the boiler house stack and No. 1 open hearth stack. The falling stacks just missed the mule shed and



An Early Day Electric Charging Machine

struck the corner of the dinkey-engine cab in which the stock foreman was eating his lunch.

The first water cooling of gas ports on Central Works open hearth furnaces was tried in 1908. On account of very short roof-life and the difficulty in maintaining them the cooling of ports has always been a serious problem of open hearth management. One inch pipes were put straight through the port end of the furnaces above the gas ports but were not very satisfactory.

Vice-President R. B. Carnahan, who was at that time superintendent at Armco, and a pioneer in the open hearth steel making, was a man about whom many interesting stories are told. He was always intensely anxious to keep down delays. Once the stripping cranes broke down at a time when it was necessary to get a pit ready for the tapping of a heat. After a great deal of effort he succeeded in attaching a block and tackle to the roof trusses. He then fastened the tackle to a mold and attempted to use the stock yard mule for motive power. All his persuasive efforts were of no avail. The mule could not budge a single mold, and the attempt had to be dropped.

In 1906, in order to improve charging time, increase tonnage, and cut down cost, Mr. Carnahan bought a second-hand narrow-gauge locomotive. The furnace men resented this innovation because they believed he was trying to make steel

too fast. No one knew how to run the engine and no one wanted to learn till he secured the help of a C. L. & N. crew.

In September 1909 ground was broken for No. 3 furnace, the capacity of which was to be fifty tons. During the period this furnace was being built it was necessary to make steel in an extremely small space because new crane girders had to be installed to carry the heavier ladle crane and heats.

At the same time the building was extended considerably in order to house the foundry, and to eliminate the derrick for breaking slag and cinders north of the old shop. A yard crane for the stock yard was set up, and a ninety-ton ladle crane was purchased.

No. 3 furnace was built for burning natural gas as fuel. As a result, a cheaper and simpler construction was possible. Both gas and air checkers were used for heating the air, as natural gas could not be preheated advantageously. One open port and one slag pocket were built on each end of the furnace. A new Blair valve was installed, as well as a new style of bottom binding for furnace iron work. In order to avoid any water trouble No. 3 checker chambers were not dug as deep as those of Numbers 1 and 2.

The first heat from the new furnace was tapped March 2, 1910. On account of electrical and mechanical troubles with the Blair valve and improperly designed port slopes of the furnace, it made only eighty heats on the first run. The Blair valve was discarded and replaced by a common

An Early Picture of Armco Superintendents and Foremen

Velte valve and the port slope was changed, after which the furnace made a better showing.

In 1910 a larger bar mill was installed at the Central Works in order to roll the increased tonnage from the open hearth department. Although on the roughing side the ingot had to be handled to a certain extent manually, the remainder of operations was largely mechanical.

In May 1911, a small ten-ton furnace began making steel for foundry and experimental purposes. The furnace was the pan bottom type built by Armco to burn gas or oil. It had only one checker chamber, one slag pocket, and one port on each end. No separate stack was built at first but advantage was taken of an apparent excess draft from No. 3 stack. This arrangement held back both furnaces and never proved satisfactory. In 1915 the capacity of No. 4 furnace was enlarged to twenty tons and the draft problem was solved by the erection of a new Ingot Iron stack.

In 1911 Knox water-cooled doors and frames were installed at Central Works on all furnaces and the old style cast doors were scrapped. This change increased the comfort and efficiency of the men very greatly so that the monthly tonnage of each furnace began to increase at once, because the men could watch their furnaces more closely with less physical discomfort.

When these four furnaces began to make steel at the Central Works, handling so many heats with the bottom pour system became a very serious problem. The stripping of ingots and the subsequent removal of sprues or runners from these ingots had to proceed with clocklike regularity unless the furnaces were to suffer delays.

The pit was undoubtedly the narrow neck of the bottle. Riser heats, "cold" heats, poor stopper equipment, and other messes kept two assistants on the jump every minute, day and night. So many ingots stuck fast in the molds and could not be stripped that the cleaning floor at times was piled twenty feet high with a jumbled mass of stickers from dozens of heats. As these stickers had to be placed out of the operating area while still red hot they rarely had any identification marks.

The mill had no stripper, and it was necessary to get the steel rolled as soon as possible. The common practice for stripping these sticker ingots was to attach the hooks of a long double chain to the lugs of each of two of these molds

and drag them out of the pile with an overhead traveling crane. The craneman then swung these molds back and forth until they were often as high as the crane girders. On the next downward swing the molds were allowed to strike a large roll on the cleaning floor. Something had to let go. Ordinarily the ingot flew out of the mold like a shot out of a cannon. At other times the molds were broken into pieces, or the chains would be torn apart. This practice was very effective in removing the ingots stuck in the molds but as the operation was carried on in the midst of an active working area, it was unsafe and dangerous, to say the least. For this reason a horizontal hydraulic stripper was built. This machine was rather clumsy and difficult to operate. Pit foremen despised the apparatus and deliberately bent the ram at frequent intervals. In consequence repair and maintenance cost was so high that the operation had to be abandoned. The men willingly reverted to the more dangerous but also more effective method of knocking out stickers with the crane.

On September 16, 1911, the first large top-pour molds were poured at the Central Works. Since that date practically all heats have been top-poured into large molds on buggies, except heats of electrical steel which were bottom-poured till January 1912. This final transition from bottom-pour to top-pour was made on completion of East Side Works where such large ingots could be handled. After that date all ingots produced at Central Works open hearth were poured into large molds resting on stout iron buggies. These buggies were moved promptly to the East Side Works and placed in the soaking pits there while they were still red hot. They were in this manner made available for "breaking down" at the new blooming mill. The old casting pit at Central Works was dug out and a depressed track served by a pouring platform was built. At this time the deep, dangerous ladle holes were eliminated.

Up to this time the foundry had hovered around the outskirts of the open hearth department, making castings for the maintenance department. Now the former mold storage space in the pit was transformed into a foundry. A separate department was created, and some castings were made for outside concerns.

The building of the East Side Works about a mile east of the Central Works, was an event in Armco's history. It began operations in September, 1911.

Three seventy-five-ton open hearth furnaces, of the most modern type known at that time, were erected in a large, airy building. These furnaces were built above the ground level and were completely enclosed in a very heavy, permanent structural steel building. Four individual checker chambers regenerated the gas and air. A producer gas plant was built parallel to the open hearth building where three mechanically-stoked revolving Hughes producers, with their complement of dust catchers, dampers, and gas mains, served each furnace. All the accessories of a well equipped steel plant, such as stockyards with traveling crane, refractory plant, skull cracker, stripper cranes, and standard gauge engines, were provided.

The skull cracker with its sixty-foot drop was a vast improvement over the derrick at the Central Works and the mechanically operated stripper crane with its powerful ram made the problem of sticker ingots of small consequence. Increased tonnages and a desire for more flexibility demanded a discontinuance of the old narrow-gauge system. Transportation at the East Side, as the new plant was named, was equipped with standard gauge tracks.

Several safety features were incorporated in the new plant design, such as wider back-standings for the furnaces, safety platforms for the ladlemen and ladle cranemen, and a change from chains on crane hoists to cables. This latter change was soon afterwards made on Central Works cranes.

From the beginning the steel at the East Side has been poured into ladles resting on ladle stands under the spout. The one hundred and twenty-five ton ladle crane then picks up the ladle and pours the steel into molds by the top-pour method. After the steel has solidified in the molds, buggies holding them are pulled to the stripper yard. There the stripper lifts the molds from the ingots and sets them in a drag of empty buggies. The ingots are then picked up by the tongs of a pit crane and deposited in modern soaking pits in the blooming and bar mill departments. After being brought to the proper temperature, the ingots are rolled on a 40″ blooming mill into blooms or billets. The blooms are then cut into suitable lengths by a large mechanically operated shear. From the shear they proceed without any reheating to the bar mill where they are rolled into either eight inch or twelve inch bars of any desired thickness from three-eighths inch to one and one-half inches. The bars are then cooled on a large cooling

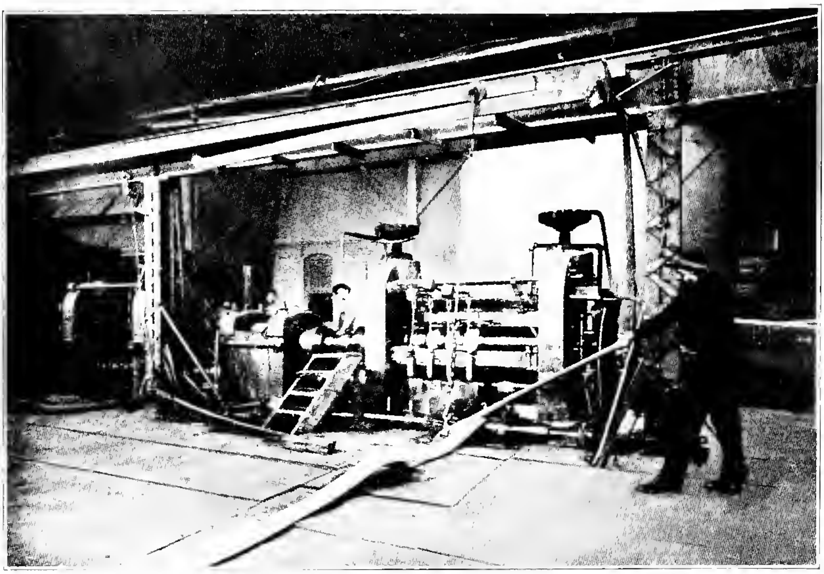
bed and sheared into thirty-foot lengths or into sheet bar sizes.

The first heat at East Side Works was poured successfully from No. 7 furnace on September 11, 1911. The other two furnaces tapped steel a short time later.

The open hearth management was faced with the important problem of creating an organization imbued with Armco ideals. The school of experience soon taught that few furnace men from other plants were fitted to operate furnaces at Armco, because their training had been to turn out tonnage irrespective of quality. The handling of Ingot Iron heats was a closed book to them, and they did not yield readily to new methods. At an early date, efforts were made to develop a crew of sober, loyal furnace men recruited from the locality and acquainted with the Armco ideal. One by one the outsiders were dropped because they were unable or unwilling to follow in the new path. The experience of the succeeding years had strengthened the belief that furnace men who had to uphold Armco's standard must be trained at Armco.

In the spring of 1912 business was dull and only one or two furnaces were operated at the Central Works. At this time No. 2 furnace was shut down for a general repair in order to remove the steel salamander which was in the bottom of the furnace and which was holding up the enlargement of the furnace. Attempts were made to dig out the steel, but to no avail, nor was the use of one-hundred-ton jacks more successful; so an expert dynamiter was secured who broke up the chunk of steel into five pieces, weighing in all five hundred and six thousand pounds. The work was very cleverly done so that no one was injured, though the piece broken was solid steel and measured eight feet thick, thirteen feet wide, and twenty-seven feet long.

During the years from 1910 to 1912 various furnaces were equipped with oil burning apparatus. At this time No. 2 furnace was changed so that it might burn fuel oil. The trials and tribulations with this fuel were very great on account of the variation in specific gravity of the oil. At times a car arrived that was almost pure gasoline making it necessary to keep an exceptionally close watch on the furnace. Again, especially in winter time, cars would arrive in which the oil was so thick that it could have been



Old Time Sheet Bar Ready for Last Pass on Finishing Mill

shoveled out. Such cars had to be heated with live steam to make the oil liquid enough to run into tanks.

In 1912 another small cyclone visited Middletown and blew down all the boiler house stacks. They fell through the roof of the bar mill building into the mill just one-half hour before the crew came out to start their Sunday night turn. No one was hurt. Great excitement prevailed. Men lost their heads and wanted to tap all the heats into the pit. Calmer judgment prevailed. The gas was shut off and the metal allowed to chill. Later, after the stacks had been rebuilt, the heats were melted without any very serious loss.

On March 25, 1913, the most devastating flood the Miami Valley has ever experienced, swept through Middletown. The Miami River, usually a very small stream, had become so swollen by melting snow and many days of rainfall, that it became a rushing torrent, carrying everything before it. At eight A.M. the banks of the Miami and Erie Canal adjacent to the mill property began to overflow. At that time furnaces Nos. 2 and 3 were ready to tap, and the iron in Nos. 1 and 4 was almost melted.

About this time frantic wives began calling their husbands home. Before long only a corporal's guard was left. No. 3 furnace was tapped. In the meanwhile as many men as could be spared were sent to the north end

THE 1913 FLOOD

1—Main Office. 2—Curtis Avenue Alongside Sheet Mill and Open Hearth.
3—Showing Depth of Water on Curtis Avenue.

of the mill to build a dam out of railroad ties and slag. Just before the pouring of No. 3 heat was completed, an enormous mass of water came rolling south on Curtis Avenue. It soon reached the improvised dam. The crest of the wave scattered the ties like chaff, and water began rushing down the depressed track. By the time all the steel had been poured into molds, the water had risen till it was above the bottom of the molds. Only the quickest work saved an explosion when the slag from the heat was dumped in No. 1 ladle hole.

Confusion reigned supreme. The water penetrated into the slag pockets and checker chambers of all the furnaces. When one considers that these chambers contained over sixty thousand white hot bricks, it is a wonder that the entire plant was not blown up at once. The steam, however, blew open all the sealed doors, which relieved the pressure in an incredibly short time. The water filled the entire pit. It came within half a foot of the top of No. 2 tap hole. It is problematical what would have happened had the molten heat in this furnace tapped its one hundred and thirty-five thousand pounds of liquid steel into this mass of water.

Oblivious to the danger they were in, furnace men threw up a small dam between No. 1 and No. 2 ladle holes while all this was transpiring. This dam, by holding back some of the water, undoubtedly saved No. 1 furnace from the fate of Nos. 2 and 3. Within half an hour a mass of boiling water, in places over fifteen feet deep, covered the entire open hearth department.

The roar of the steam escaping from the checker chambers could be heard for a great distance. The steam rose in a solid column many hundred feet over the furnace building. A short time later, when the water floated the open hearth underground oil-tanks, the oil flowed out of the broken connections and was carried under the boilers by a current of water.

There the boiler fires set the oil ablaze and a fire chemical wagon had to be dragged through the water from the factory to extinguish the fire. The assistant superintendent of the open hearth department and two others stayed in the plant all day. At night, on oil barrels nailed together in the form of a raft, they ferried themselves from the factory entrance, which is part of the old office across Curtis Avenue, and landed in the yard of the research building.

Four days later, after the water had subsided, the entire plant presented a woeful spectacle. Slime and mud covered everything. The sight of such devastation, the ghostly silence, and the stench of the mud reminded one of the stories travelers tell of abandoned cities in plague infested regions of Asia.

Formaldehyde had to be scattered everywhere to protect workers from disease. The open hearth furnaces were a sight to behold. The bottom of No. 3 furnace was a mass of powder filling the entire furnace. The heat of steel in No. 2 furnace had been forced up to the roof of the furnace by the expansion of the bottom materials. No. 4 furnace was warped badly. The iron work and roof of No. 1 furnace had become badly bent and shoved out of line by the expansion of the brick work. For once a steel salamander in a bottom was an asset as it prevented the bottom from slacking. Though only a caricature of its former self, the furnace was immediately lit up and made a creditable run before it had to be torn down.

After all the iron work of the furnace had been removed, the steel heat in No. 2 furnace had to be shoved into the pit with very large jacks, a job which was very difficult due to the lack of a crane over the furnace. No. 3 bottom was shoveled out.

It is worthy of note, as evidence of the improvement in furnace practice, that when these two bottoms were taken out, very little steel was found in either although No. 3 had been operating more than three years. This makes a very favorable comparison with the two hundred and fifty tons taken out of No. 2 at an earlier date.

November 26, 1913, No. 8 furnace was finished and the first heat tapped, which completed the unit at the East Side Works as originally designed.

All furnaces were run till the summer of 1914. August saw the outbreak of the World War. In a very short time business came to a standstill. Central Works open hearth furnaces, with the exception of No. 4 furnace, were shut down, and in the spring of 1915 only two furnaces remained in operation at the East Side.

In May, 1915, orders for steel forgings for Russian shells began to increase the demand for steel so that by late summer of that year all the furnaces were again in operation at both works.

Armco's long experience in making high grade iron and steel enabled the company to produce the very difficult grade of steel needed for high explosive shells, without any delay.

When the war broke out, several essentials in open hearth furnace practice disappeared. Among these items were Austrian and Grecian magnesite, ferro manganese, chrome ore, and magnesite brick.

A stock of three hundred thousand pounds of Austrian magnesite on hand when Germany declared war was put under lock and key for future use.

Magnesite brick disappeared entirely; consequently clay brick had to be used in the front and back walls and in the ports of the furnaces. This practice gave fair results in other plants; but at Armco, on account of the manufacture of Ingot Iron, this practice was extremely costly and disastrous. Breakouts were very frequent thru the necks, front and back walls. Much steel was lost, furnace binding was badly damaged, and chill boxes were filled with steel. Nos. 7 and 8 furnaces had to be completely rebuilt in 1919, partly on this account.

The lack of high grade chrome ore was very seriously felt in the manufacture of Ingot Iron, because of the necessity, when making this grade, of using large quantities in ports, tap holes, and jams of doors. Often chrome ore, specified as 45% chromic oxide and under 6% silica, would arrive with 25% chromic oxide and as high as 30% silica, making it practically worthless.

English ferro-manganese was a standardized, uniform product before the war. The American substitute was very irregular in physical and chemical properties, and gave a great deal of trouble in the making of certain grades.

In 1915 No. 4, an experimental furnace at Central Works, was enlarged to a twenty ton furnace and the bottom was burnt in with magnesite and slag.

In the spring of 1916 the capacity of the East Side open hearth department was increased by the addition of four one-hundred-ton furnaces. Once again the department was called upon to make maximum tonnage while major building operations were being pressed to completion. No. 9, the first furnace finished, tapped a heat on September 25, 1917. The other furnaces were lit in succession till No. 12 was making steel on December 15, 1917.

All the auxiliaries, such as enlarged stock yards, gas producers, charging machine, ladle crane, stripper crane, and new mold yard were added at this time. The same style of valves as those on the small furnaces was installed and electrical control was provided for doors and valves. A new type of back standing was installed and other slight modifications were made, but, as a whole, the original design was continued.

Operating difficulties during all the years of the war were very trying. Some new obstacle came up constantly. The climax probably came during the winter of 1917. In that fall the transportation problem began to grow very acute. The Government was bending every effort to speed up shipments of soldiers, supplies, and munitions of war. Commercial freight business became very badly demoralized, and it was difficult to obtain supplies. Furthermore the winter of 1917 was the coldest in twenty years. Hundreds of trains were stalled for weeks behind snowdrifts. Shipments were weeks and months overdue. The men of the sales department had to be called into service as traffic men in order to speed up belated shipments of raw materials so that the open hearth department could continue to operate.

In the meanwhile the open hearth management had to divide the time between keeping pipes thawed out, molds dry, tracks cleared of snowdrifts, and devising substitutes for supplies that did not arrive. The hydraulic jacks immediately on top of the furnaces froze while the furnace was in operation. On December 6 the temperature went to ten degrees below zero and operations almost ceased. Large kettles of coffee had to be kept steaming in order to get men outside to load the scrap and pig iron.

Later in the winter, on many occasions, the department came within twenty-four hours of a complete shutdown, due to the exhaustion of a certain supply. Then relief would come. The very next day the same condition might occur from the lack of some other material. At times heats had to be poured through sleeve brick. At other times nozzle brick had to be used as sleeve brick. Molds had to be poured till they simply would not hold any more steel. Any common brick had to be bought for use in the ladles so that at times a ladle lining would last only one heat.

The coal received at the gas house was often little better than coal from a coal dump. It was full of slate, and often very finely divided. The producers clinkered very badly, and the gas produced was of such poor quality that heats had to be held in the furnace for many hours. This caused "cut banks," bad furnace bottoms, "off analysis" heats, and other troubles.

From a furnace maintenance standpoint, the most serious problem faced by the open hearth department at the East Side was the wear and tear of ingot iron heats on the furnaces. In this connection, the question of an adequate supply of clean, cool water to cool essential parts of the furnaces was uppermost in every one's mind. When the East Side furnaces were originally built the supply of water was sufficient to take care of the open hearth needs because fuel oil was used. Later, when producer gas began to be used, the problem of protecting the gas port became important.

As dry ports were hard to maintain and never were satisfactory, a patented Parks' port was installed, and gave good results until No. 8 furnace was built. The water supply then became inadequate. Further troubles resulted whenever the water supply was discontinued, even for a short time, due to electrical storms or some other cause which put pumps temporarily out of commission; for at such times all the water-cooled pipes would burn out.

Furnace maintenance became so expensive and loss of tonnage so serious, that a new circulating system was installed at the time the new furnaces were built in 1917 in order to prevent the water being shut off when the river pump failed. As this system used the main mill supply, in order to economize on the use of water, it was never satisfactory, because the initial temperature of the water was too high for such "hard" water.

In the year 1920 an entirely new water cooling system was devised and work was begun on its installation in the fall. A large, concrete cooling basin, one hundred and forty-two feet by ninety-four feet with three-inch spray cooling nozzles was built several hundred feet from the open hearth plant. All waste water from the open hearth department runs to this pond by gravity. The cooled water returns by gravity to the open hearth pumps, south of the open hearth building, which have sufficient capacity

(six thousand gallons a minute) to supply all needs for water cooling furnaces.

The make-up water, which should not exceed 3%, will consist of treated, filtered water, and therefore should cause very little deposit in cooling equipment.

A great deal of excitement was caused in the spring of 1918 when No. 9 furnace at the East Side Works blew up an hour after it had been charged. The gas checker roofs and the entire main roof from end to end were blown off. Because the explosion happened in war time, the belief was expressed that foreigners had blown the furnace up with dynamite. To this day the exact cause has never been discovered.

The Armistice on November 11, 1918, changed conditions in the space of a few days. War orders were cancelled, and Central Works open hearth department, with the exception of No. 4 furnace, was shut down. The organization was transferred to the East Side, and absorbed in the East Side open hearth organization.

The shut down of the forge shop curtailed operations still further. On account of the lack of orders no heats were made from January 24 to February 9, 1919, and during the greater part of the year 1919 only six furnaces were operated. As they were manned by the pick of the crews from both works, excellent results were obtained.

In August 1919 the management decided to study the possibility and advisability of instituting the three-shift day in the open hearth and the blooming mill departments. Accordingly, the betterment department began to make a very detailed survey, and study of open hearth organization and operations.

In midst of this work, in which the furnace men gave a great deal of help, the much heralded "great steel strike" was called. Men of Armco, true to tradition, did not give the strike very much attention; but during October, when the strike was at its height Armco proceeded to break all monthly tonnage records for the year. Representatives of the steel strikers visited Middletown and interviewed several of the open hearth men. Their reception was so cool that they left immediately.

In December 1919, as the effects of the steel strike began to wear off, the entire country was paralyzed by the coal strike. As all manufacturing establishments require large tonnages of coal, this strike struck home at once.

But farsightedness had prepared Armco for just such an emergency. Central Works open hearth department, after a year's shut down, was started and in a short time was making steel, using oil as a fuel. East Side furnaces, though built for producer gas, were converted temporarily into oil furnaces in forty-eight hours. As a result, Armco did not shut down, and orders began to come in from all sides.

In the meanwhile the study of the three-shift plan had continued for a period of more than six months without hindrance, and on March 1, 1920, the open hearth department began to operate on the three-shift basis.

In a short time the organization had expanded from a six- to a twelve-furnace crew. In addition, one-third more first and second helpers had to be created to put the new scheme into effect. Again the leadership and assistance of the foremen had to save the day. It was a risky undertaking. Many of the first helpers had not had very much experience in running a furnace; but their enthusiasm, willingness to learn, and cooperation with their foreman were great assets and the men produced results.

This change from the two-shift day to the three-shift day, was not actuated alone by a desire to improve working conditions. The conviction had been formed that men on continuous operation of twenty-four hours a day, could do more and better work without raising the cost if they worked eight hours a day instead of twelve. One of the main conditions of the change was that cost must not be increased or the scheme would be economically unsound.

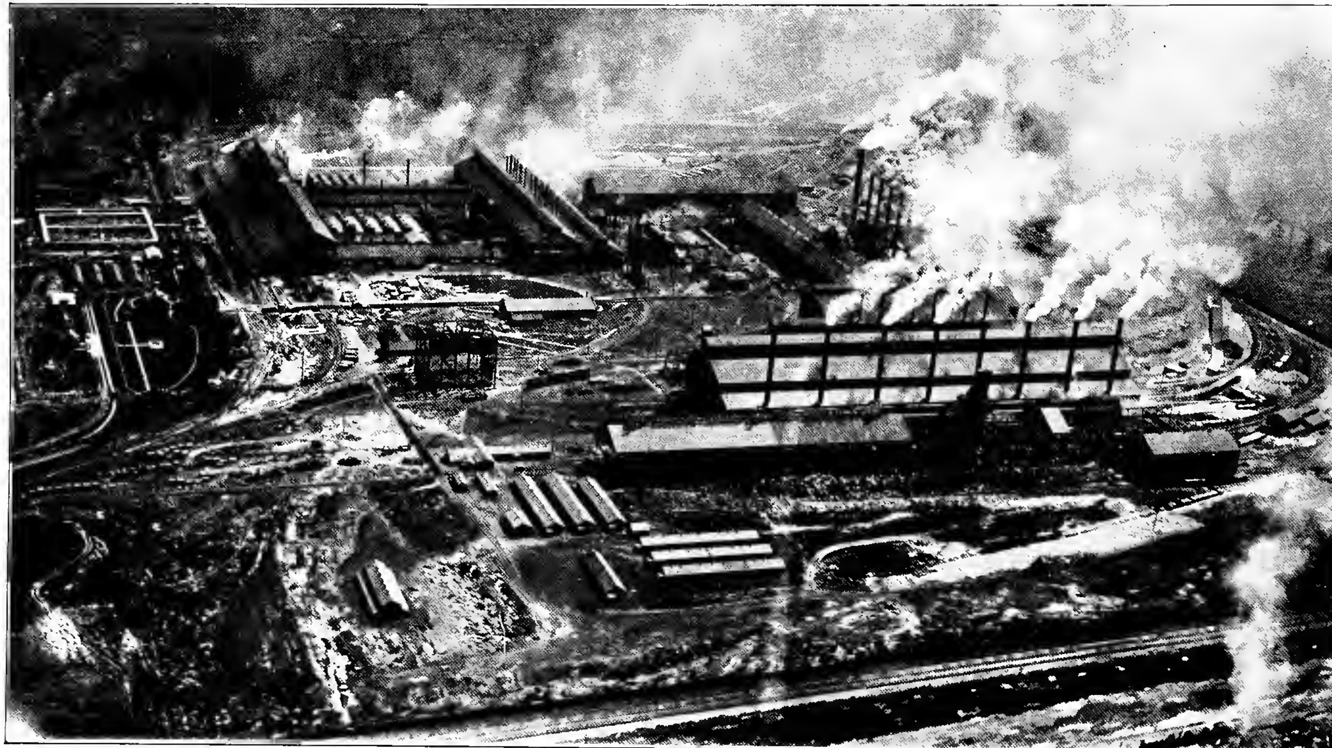
There is no doubt that men, who for many years had worked the two shifts, now had more time to spend with their families. Home held a new meaning to the whole family which acted as an incentive for better and more efficient work.

Following on the heels of the coal strike came another one in the form of an "outlaw railroad strike." Like the former, it struck at the very vitals of manufacturing, and quickly produced a depression in business. The traffic department was again called upon to expedite shipments in and out of the plant. Again Armco did not shut down any producing units. The greatest difficulty encountered was the job of getting sufficient pig iron from Columbus to Middletown.

During the summer of 1920, needed repairs for the Columbus blast furnaces brought the open hearth department to such a point that for weeks the pig iron on hand at the steel furnace in Middletown could almost be counted at the beginning of each day. The company was forced to buy any pig iron it could get, which resulted in the purchase of an odd assortment of off-grade pig iron. In the use of this material great care had to be exercised in order to keep furnace and quality troubles at a minimum.

In the fall traffic conditions improved. Supplies began to come in on schedule. Columbus blast furnaces were again in operation, and were turning out pig iron at a rapid rate. The organization was keyed to top notch for a record production, when almost out of a clear sky, came the "buyers" strike, the beginning of the Great World War readjustment period.

In this narrative, chronological as far as possible, an attempt has been made to hit only the high spots in the open hearth department's variegated history during these twenty years. Accidents, messes, lost heats, and other more or less spectacular operating difficulties are the exceptional events, and thus make history. At the same time, in between the lines should be read the gradual, steady, and substantial progress from the archaic methods of steel manufacture in the early days, the lack of care in steel making, and the disregard of the human element, to the present highly developed modern practice with its many ramifications, both in operation and in quality control; and to the development of an industrious, sober, loyal organization able and willing to carry out the ideals of Armco's founders, and to impress quality in all of Armco's products.



Aeroplane View of "Armco" East Side Works, Middletown, Ohio

Chapter III

History of the Zanesville ARMCO Plant

The Building of the Zanesville Plant—The Work of the Citizens League—Rolling of the First Bar—Merger With ARMCO—Making Tin Plate—New Additions to the Plant—The Zanesville ARMCO Association.

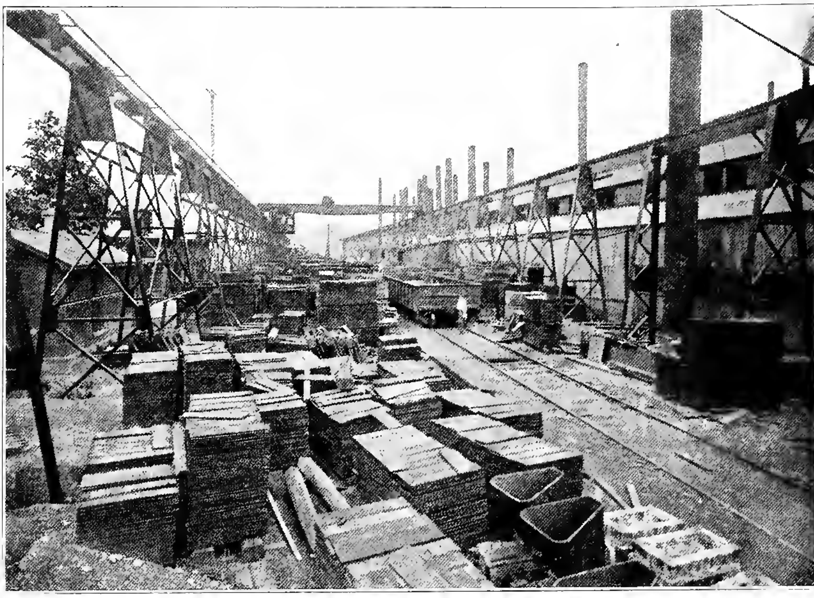
GROUND was broken for the erection of a sheet mill plant, now known as the Zanesville Division of The American Rolling Mill Co., in the city of Zanesville, Ohio, May 1, 1901. The corporation back of this enterprise was known as The Curtis Sheet Steel and Corrugating Co.

The location of the plant in Zanesville was brought about by chance conversation at the Clarendon Hotel between a traveling man and the president of the Citizens League of Zanesville, an organization which preceded the Chamber of Commerce. The traveling man happened to mention that he had been told by two fellow passengers who had just entered the hotel that they represented a steel concern and were going to locate a plant in Coshocton, Ohio.

Through the manager of the hotel, the president of the Citizens League was introduced to the strangers, who proved to be E. H. Curtis and Lou Jack. A strong bid was made for locating the new plant at Zanesville. The directors of the Citizens League were called on the phone and a meeting arranged for although it was then past 10 o'clock at night, and when the meeting adjourned at 2 o'clock the next morning a rolling mill was assured for Zanesville.

Associated with Mr. Curtis in the enterprise were some of the men formerly employed by the Hyde Park Iron & Steel Co., which had been taken over by The American Sheet & Tin Plate Co. Some of the rollers still engaged were among the original stockholders.

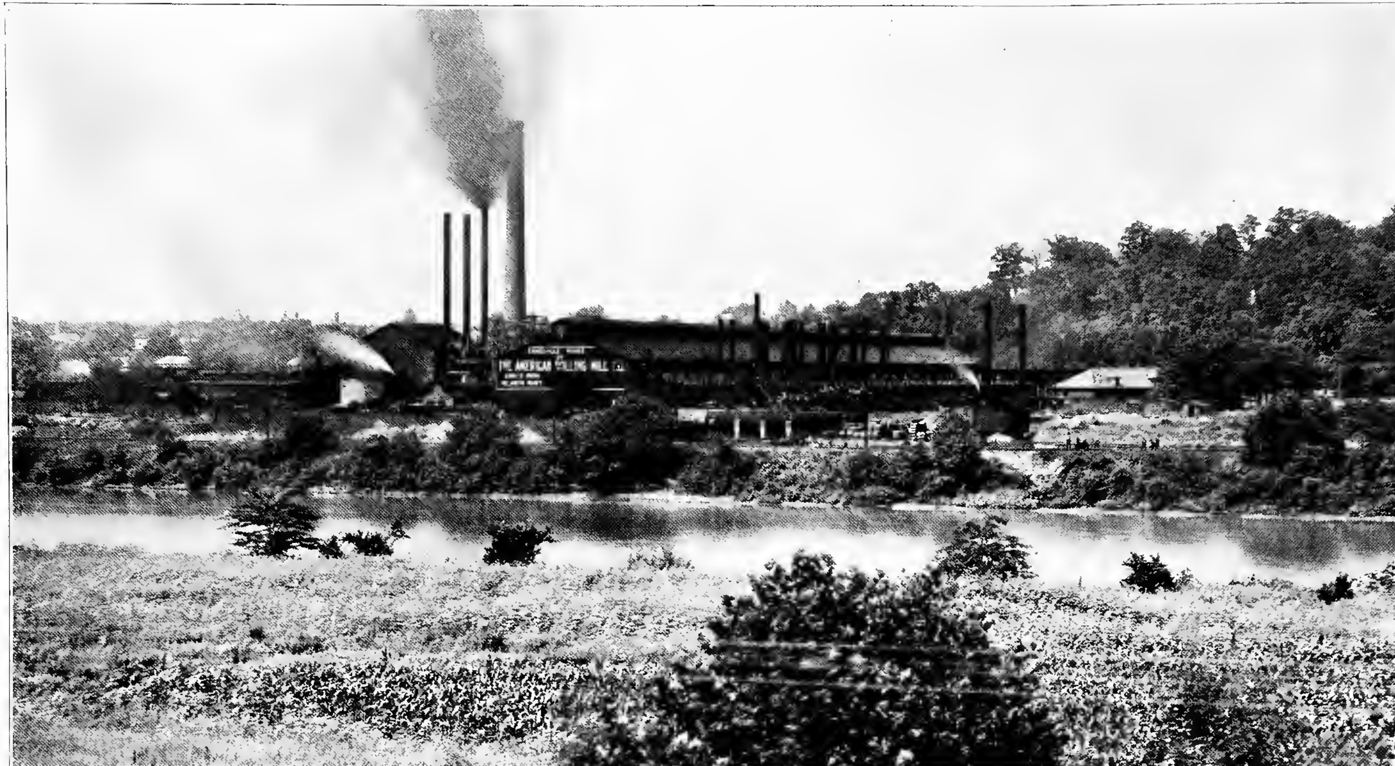
The original plant consisted of a bar mill and four sheet mills. The first bar was rolled October 15, 1901, and the following day the first sheet was rolled with two mills operating.



Bar Storage at the Zanesville Plant

Much was expected of the new plant. The venture, however, was incompletely financed and in a short time found itself in deep water. In 1902 the principal interests were taken over by W. S. Horner and business associates, of Pittsburgh, Pa., and the name of the corporation was changed to The Muskingum Valley Steel Company. From 1902 to 1905 the plant operated under more favorable circumstances, and the fifth and sixth mills were installed. During this time Mr. W. S. Horner took hold of the executive management of the business and was in charge of sales. In this connection he made several trades with The American Rolling Mill Co., of Middletown, in which Armco furnished the bars against which the Zanesville concern supplied sheets. Independent purchases of steel bars from Armco were also made and the two concerns drew closer and closer together in their business relationship. After several years' trading of that sort, a merger was suggested and effected on June 24, 1905. Mr. W. T. Simpson, Vice President of The American Rolling Mill, took personal charge of the Zanesville plant, which position he held until his death in 1915.

The Zanesville plant has shared in the activities and growth of Armco. In the spring of 1912, work was started covering the erection of a tin house consisting of six com-



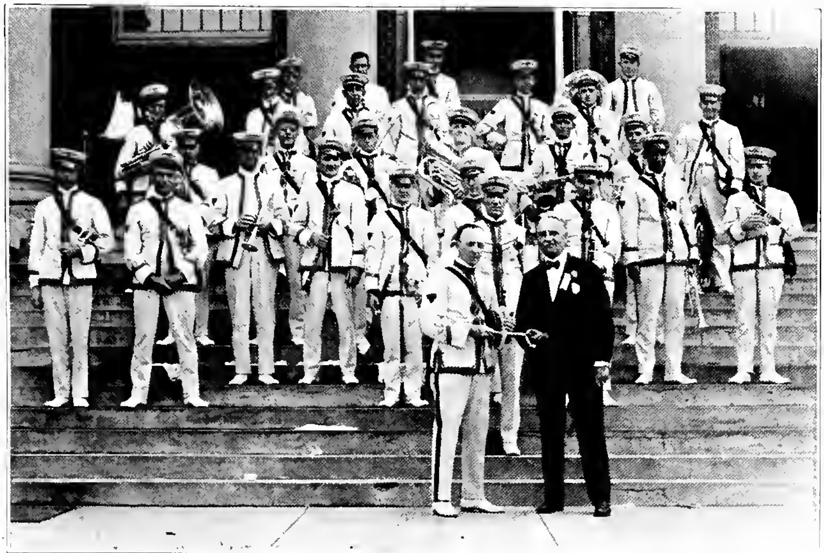
Early Picture of Armco Plant at Zanesville, from Across the Muskingum River

plete sets of tin stacks. The manufacture of terne plate was started in April, 1912, but it did not prove a satisfactory venture and was discontinued August 1, 1916. In later years the plant has chiefly been engaged in making high-grade electrical steel sheets for which there has been a large and growing demand.

As the business continued to grow, additions were made from time to time to the Zanesville plant. A seventh sheet mill was added to the plant and it began operation on April 17, 1916; the eighth sheet mill on July 17, 1919; and the ninth sheet mill on February 9, 1920.

In the great period of industrial expansion which took place in Armco during 1920, a group of business men representing the Zanesville Chamber of Commerce and the city officials visited Middletown with an earnest petition that a considerable part of Armco's expansion be made in Zanesville. The board of directors of The American Rolling Mill Co. held their next meeting in Zanesville and went over the situation very thoroughly. As a result, the first of January 1920 saw the work started on the construction of a complete new "four-mill" unit at Zanesville—also large extensions to the power department, annealing department, warehouse buildings and crane runways. This development

Sheet Mills at Zanesville Plant



The Zanesville Armco Band on a Visit to Middletown

provided a substantial increase in the industrial life of Zanesville and gave employment to 200 to 300 men, making the total personnel of the Zanesville plant then approximately 800 men.

The new sheet mill building is 90 x 200 feet and is most modernly equipped throughout. The roll train is driven by a 1000 H.P. electric motor. In the extension of the annealing building, eight new annealing furnaces were provided. A 750 kilowatt turbine engine, with room for another of the same size to be added later, was installed in the new power house, which more than tripled the former power of the plant and provided ample power for the driving of the new mills by electric motors. A new brick stack 7 ft. in diameter and 200 ft. high and a new 600 H.P. Stirling boiler were added to the boiler plant. A large pumphouse was installed on the Muskingum river to provide ample water for the operation of the high and low pressure turbines.

The new four-mill unit at Zanesville started operation January 17, 1921, the first sheet being rolled by D. S. Dodds, who rolled the first sheet in the original Zanesville plant October 16, 1901.

The employees of the plant at Zanesville are loyal and enthusiastic. The system of promotion which applies all through the Armco organization applies in Zanesville

where "roughers" and "sheet heaters" are advanced to the positions of "rollers," the "pair heaters" to "sheet heaters," the "catchers" to "roughers," the "doublers" to "catchers" or "pair heaters," and the "matchers" to "doublers." The advancement is based on length of service with the company and ability to hold down the new jobs.

The Zanesville Armco plant is distinctive for the large number of young men from the farms and outlying sections of Zanesville who have heard the call of industry and found their first position with The American Rolling Mill Co. Young men enter the organization at the bottom of the ladder and climb round by round. A large number of the men occupying responsible positions at the Zanesville plant stepped directly from the farm into the steel works. Sometimes the advancement has been very rapid, depending upon the aptitude of the person and also upon the growth and expansion of the business.

The Armco Association at Zanesville is an integral part of the Armco Association with headquarters at Middletown. It has its own club room where Armco men and their families meet for social diversion. The Zanesville Band, the Mando Club, the Orchestra, the Drum Corps, the Baseball Team and the Clown Band—all of these go to make up the recreational forces of Armco at Zanesville. A cordial relationship exists between the men of Zanesville and the men of Middletown, and on National Armco Day, September 25, 1920, the band from Zanesville and many hundreds of the employees made a pilgrimage to Middletown where they helped to make the day a great success.

For years the Armco Association at Zanesville was housed in one of the large buildings in the main part of the city. Later it was moved into a commodious club house near the plant. A new Association club house and entertainment building with athletic grounds adjacent are now planned. When this is completed the Armco Association of Zanesville will have a real home that will give happiness to the men and their families for years to come, as the Zanesville plant continues to grow with the larger destiny of Armco.

Chapter IV

The Advent of the Blooming and Bar Mill

Change to Big Mill Practice—Description of Blooming Mill Practice—Practice of First Year—Growth in Tonnage—Extension of Equipment—Eight Hour Turn and Production on Bonus—Tonnage Records.

THE operation of the blooming and bar mill department of the American Rolling Mill Company when the East Side Works was completed in 1911 was an epoch making event in the company's history. It marked the change from small scale to large scale production with the greater economy and efficiency which that entails. Formerly it had been necessary to pour small ingots for the bar mill. With the new blooming mill large ingots could be poured, production speeded up, and a vastly greater tonnage secured.

When the ingots are extracted from the ingot molds by powerful stripping cranes they are solid on the outside but still in a molten state within. In order to bring the ingots to a solid state and a uniform heat, twelve soaking pits with cranes for handling the ingots were built and put into operation immediately adjacent to the blooming mill. In addition there was a crane in the blooming mill and another in the slab yard.

After the ingots have reached a uniform temperature, in the soaking pits, the soaking pit crane delivers them to a roller table in the blooming mill. In the mill the white hot ingots are guided back and forth through the blooming rolls until they are reduced to the proper size for the bar mill. Three men on a platform overlooking the blooming mill control the ingots during the rolling process. Each of these has a different duty to perform but each must coordinate with the others in the manipulation of the heavy machinery.

In the blooming and bar mills, ingots from the soaking pits are rolled out thinner and thinner till at the close of the process the ingot has taken the shape of a long narrow thin bar which after being cut into short lengths at the bar mill shears is ready to be rolled into sheets or light plates.

Rolling the First Ingot

The blooming mill began operations on September 9, 1911, and for one month operated on one twelve-hour shift per day until the East Side bar mill got into operation after which it went on two twelve-hour shifts per day.

During the month of October, 1911, seven thousand, four hundred and ninety-three tons were rolled. In November, the month following, nine thousand, five hundred and ninety-three tons were rolled; but in December the tonnage decreased to eight thousand, one hundred and thirty-two tons. In 1912 the blooming and bar mill operated all year on two twelve-hour turns. A total of one hundred and twenty thousand, nine hundred and fifty-nine tons was rolled, the record month being November with twelve thousand, two hundred and thirty-three tons to its credit. The efficiency of the department was somewhat increased by the addition of a new crane in the slab yard to handle the tonnage of sheet bars.

The year 1913 showed an increased tonnage on the blooming and bar mill, a hundred and thirty-five thousand, seven hundred and sixty-seven tons being rolled with a record of fourteen thousand, one hundred and fifty tons for the month of January. The two twelve-hour turns continued until November 24, when the remainder of the year was finished on one twelve-hour turn.

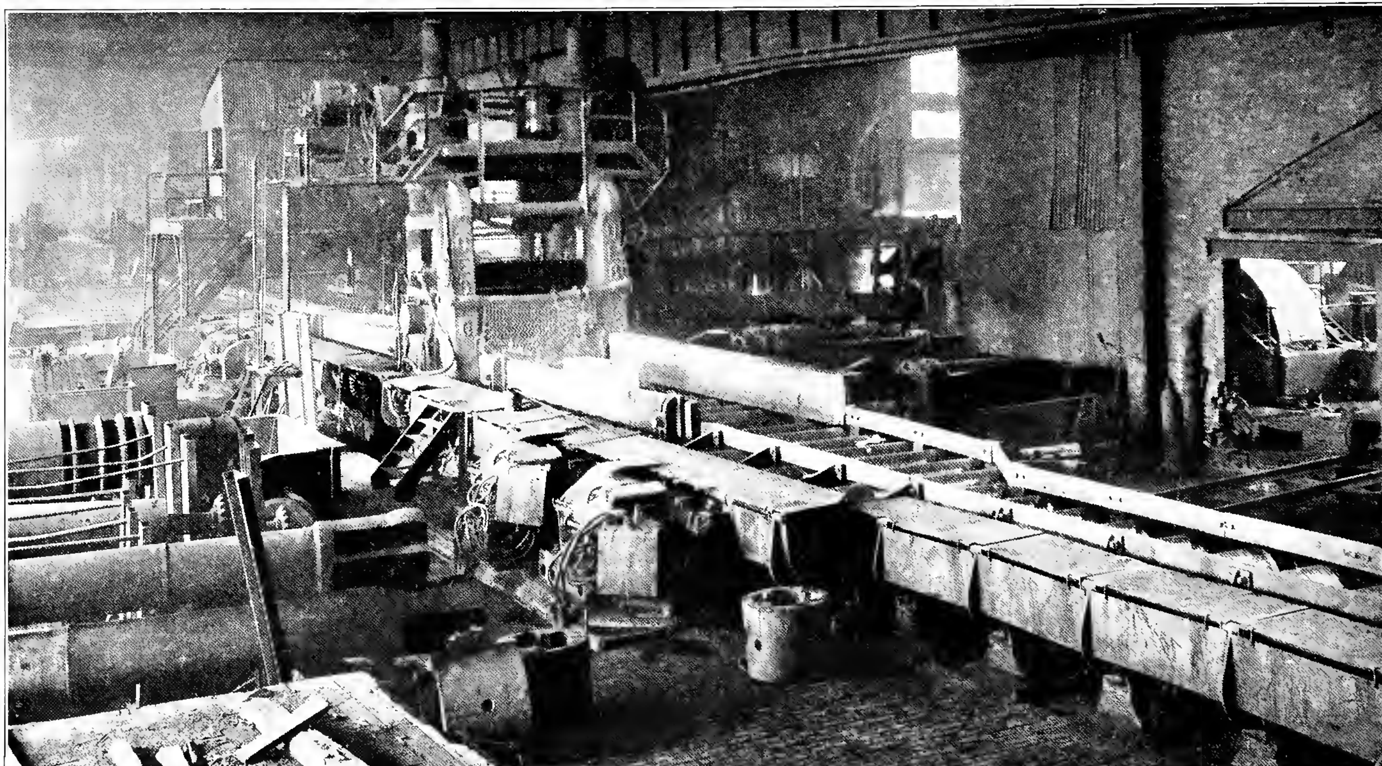
January and February, 1914, saw the blooming and bar mill continuing on its single turn, but the double turn was resumed on March 3, for three months, after that time it was replaced by the single turn for the rest of the year.

Conditions did not improve in the blooming and bar mill until May 19, 1915, when it went back on double turn for the rest of the year. A large amount of new business came from orders for steel forgings for shells for the Russian government. This business began in May and extended to November. A total of one hundred fifty thousand, one hundred and seven tons were rolled during the year, the record month being December with a production of fifteen thousand, nine hundred thirty-seven tons.

The year 1916 saw the blooming mill operating on double turn throughout the entire year, during which time it rolled one hundred eighty-seven thousand, one hundred sixty-three tons, of which twenty-four thousand, eight hundred and sixty tons were shell steel for the British government. The record month for this year was December which showed a tonnage of sixteen thousand, seven hundred and nine tons.

The full double-turn operations were continued during the year 1917, with a total production of two hundred nineteen thousand, one hundred seventy-seven tons. By this time the blooming and bar mill was getting into its stride. The single turn record of the mill was broken May 13, 1917, when No. 1 turn rolled three hundred and twelve ingots, or six hundred seventeen tons. The monthly record was also broken with a total tonnage of twenty thousand, eight hundred and eighty-three tons. During this year the soaking pits were extended and a new stripper crane installed, in order to take care of the rapidly increasing tonnage of the mills.

The year 1918 saw a still further increase in the number of tons rolled, the total tonnage for the year being two hundred and twenty-four thousand, two hundred and twenty-five tons, with the mill operating double turn. The record month was October when twenty-five thousand, forty tons were rolled, and the single turn record was also broken June 25 when three hundred seventy-six ingots, or a total of six hundred seventy-eight tons, were turned out.



The Blooming Mill

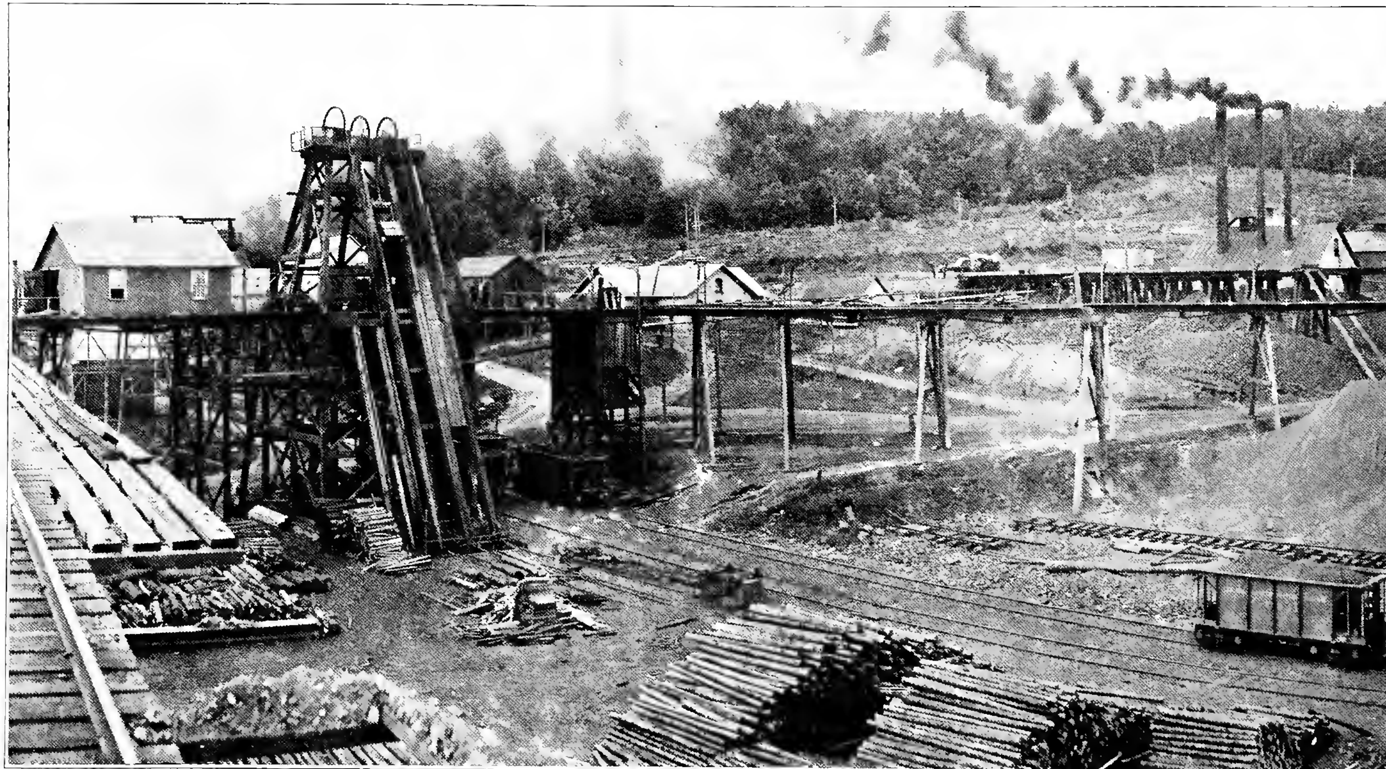
A new chipping building used in the manufacture of shells was completed during this year, and the blooming and bar mill saw a number of special improvements. The mill roller's pulpit was moved back and a high transfer, a forty-inch saw, tables, and other equipment were installed in the bar mill, in order to facilitate production.

During the year 1919 the blooming mill did not break either its yearly or monthly production record, falling behind the previous year's record by twenty thousand tons, and failing to equal the monthly production record by about five thousand tons. During this year some two hundred men who had been busily engaged chipping the billets for shell forgings, were permanently discharged and the department closed down.

During the year 1920 the blooming mill crews made a determined effort to break all former production records. Their efforts were crowned with success as during the year the mill turned out two hundred and ninety thousand, two hundred forty-seven tons, the record month being March when thirty thousand two hundred thirteen tons were rolled. It was during this year that the blooming mill was put on the three-shift basis, with a tonnage bonus. The best run for an eight-hour turn was made on June 6, when five hundred fifty-five tons were rolled, and the record for a twenty-four-hour day was made February 18, with a production of thirteen hundred and twenty-six tons.

The average tonnage for an eight-hour turn during the year was three hundred fifty-eight tons, and the average production bonus paid was 35%.

In eight years without anything like a proportionate increase in equipment the blooming and bar mills more than doubled their output. Their production of roughly one hundred twenty-one thousand tons in 1912 contrasts sharply with the two hundred ninety thousand tons rolled in 1920. Its record during that period stands as an index to Armco accomplishments in the past and is an indication of what may be expected in the future.



Eureka-Asteroid Mine of the Castile Mining Company, Ramsey, Michigan

Chapter V

The Blast Furnace Division

Properties of the Blast Furnace Division—Construction and Equipment of Blast Furnaces—Limestone Supply—Coke Supply—Coal Supply—Transportation Companies.

THE Blast Furnace Division of The American Rolling Mill Company, producing the pig iron for the Middletown works, consists not only of its blast furnaces and coal mines, but also of coke ovens, iron ore mines, timber land, and transportation lines, with generous reserves of coal, iron ore, and timber; a long-time contract for limestone provides the blast furnaces with a full supply of excellent flux. Thus the Blast Furnace Division controls its own raw materials, being practically self-contained, and thereby assuring dependable sources for pig iron and fuel for the open hearth furnaces and rolling mills.

At the close of 1920 the Blast Furnace Division owned wholly or in part the following properties, the history and development of which form an interesting chapter in the growth of Armco from a small plant to a great corporation.

	Annual Capacity
2 blast furnaces	240,000 tons pig iron
1 sinter plant	24,000 tons sinter
1 by-product coke plant with its own coal mine	360,000 tons coke
3 coal mines	300,000 tons coal
21 iron ore mines	2,000,000 tons iron ore
19 lake ore vessels	156,400 tons carrying capacity
9500 acres timber land	

In these properties are reserves of more than eighty million tons of coal, fully forty million tons of iron ore, and at least eight million feet of timber.

These properties were acquired by The American Rolling Mill in 1917 when it effected the merger with The Columbus Iron and Steel Company whereby the two companies were consolidated, payment being given for the Columbus Company in stock of The American Rolling Mill Company.

In the autumn of 1899 a group of men, already engaged in the manufacture and sale of pig iron, conceived the idea of building two blast furnaces at Columbus, Ohio, for the manufacture of merchant pig iron. In this they were no doubt influenced by the fact that Columbus was located in the center of a heavy consuming district with advantageous rates of freight, which opened up a wide territory to the sale of its products; also by the unusual transportation facilities, eight lines of railroads at that time entering the city. Columbus is located near large limestone deposits suitable for flux, but its greatest advantage is its location directly in the path of the stream of coal that goes from West Virginia and Kentucky direct to the Great Lakes region, and in the path of the great stream of ore going in the opposite direction from the Great Lakes to the interior furnaces.

Construction work on the new plant was started late in 1899, and the first furnace was blown in on October 17, 1900. The east furnace was completed the following winter and blown in on April 9, 1901. These furnaces and the sinter plant, which was later constructed, are located on an eighteen acre tract adjoining the southern corporation line of the city of Columbus. It has direct connections with the Hocking Valley and the Toledo & Ohio Central railroads. To the east of Parsons Avenue, which bounds the east side of this eighteen acre tract, the company owns eighty-two acres of land. Part of this land is used for the work of the plant, part for an industrial Y. M. C. A. for playground, baseball field, and athletic grounds, about twenty acres for employees' gardens, and the rest is rented out as farm land.

Compared with merchant blast furnaces of that period, the two furnaces when built represented the most improved designs and attracted much favorable notice from trade journals. The double skip hoist which was designed for the use of the Columbus blast furnaces was a great invention and in general design has not been improved upon since. With minor alterations these skips are still in use at the Columbus Works.

The two blast furnaces as originally built were seventy-five feet high with seventeen foot bosh, both with a capacity of about one hundred seventy-five tons a day. The original boilers and blowing engines have been entirely replaced with up-to-date equipment, which includes two

Interior View of Cast House

blowing engines for each furnace and an extra one which can be used on either furnace in case of necessity.

The original pig beds were of sand, requiring long cast houses which have been entirely replaced by the steep roofed steel cast houses adapted for casting into pig machines. In 1905 the sand pig bed at east furnace was replaced with a cast iron "chill" pig bed for the making of basic iron, and in 1910 this improvement was made at west furnace. These "chills" were used for all grades of pig iron up to the time of installation of modern, single strand pig casting machines with overhead cranes and "short pour" seventy-five ton casting ladles in 1916 and 1918.

Originally, wooden trestles were used for the storage of ore and the unloading of coke and stone, but these have since been entirely replaced with steel trestles, and steel bins. Until 1914 all the ore and limestone was loaded into hand buggies and dumped into the skip cars. In that year electric scale cars were installed and the practice of handling all material directly through steel bins and these electric larry cars was begun.

In 1909 the first locomotive crane was put in service. The use of cranes has developed until at present all pig

iron is handled with a magnet crane, and all ore and other material is moved by twenty-five-ton bucket cranes. Before the installation of these labor-saving devices about three hundred men were required to operate the furnaces, but at present one hundred fifty men are able fo obtain considerably more tonnage than could the old crew of three hundred.

The Columbus blast furnaces are unique in regard to their water supply. Usually blast furnaces are located near rivers or bodies of water in order to obtain the large quantities of water necessary for cooling, and for the boilers. Underlying the whole of the Columbus plant is a body of limestone gravel extending from a few feet below the ground level to as deep, in some places, as ninety feet. This gravel contains a large body of underground water estimated to be a total of about fifty-seven million gallons. For over twenty years water was pumped through driven wells, the steam pumps being placed in pump pits from twelve to twenty feet below the surface of the ground. At times the water would "drop away" from the pumps, making it necessary to drive the wells deeper. Finally it was decided (in 1920) after a thorough investigation of the available water supplies, to install a Layne and Bowler deep-well electric pump capable of producing one million gallons every twenty-four hours.

Gradually the capacity of the two furnaces has increased from one hundred thousand tons per annum to two hundred forty thousand tons in 1920. In the first twenty-one years of their history the two furnaces together produced two million four hundred twenty thousand tons of pig iron, the record year being in 1920 when the production rose to one hundred eighty-six thousand, seven hundred and eighteen tons.

In spite of the fact that repairs were badly needed on both furnaces they were kept in continuous blast throughout the entire period of the World War. But as soon as the armistice was signed plans were made for the complete reconstruction of the two furnaces, and the eight hot blast stoves. Ordinary repairs would not have sufficed because the long run made a thorough rebuilding imperative. When this reconstruction was completed the Columbus Works was thoroughly modernized in every detail except for the ore handling system which lacked an ore

bridge and transfer cars. The total capacity was then increased to seven hundred tons of pig iron a day.

The end of the first twenty years of history finds the Columbus Works better equipped than ever before for the production of a large quantity of pig iron on an economical basis. This favorable situation was due in part to the rebuilding of the Columbus Works and in part to the development of the raw material properties which had been much improved in the years just previous.

The limestone for flux at the Columbus blast furnaces has come almost entirely from quarries along the west bank of the Scioto river just north of Columbus. At intervals some dolomite from quarries near Springfield, and also from near Sandusky, has been used.

Steamship A. M. Byers

Up until 1909 the Columbus Iron & Steel Company owned and quarried its own flux through a subsidiary company known as the Franklin Stone Company which owned the Franklin Quarry consisting of about twenty acres. But at that time all the capital stock of the Franklin Stone Company was sold to the Casparis Stone Company, and its successors, The Marble Cliff Quarries Company, from whom the Columbus Works has purchased all its limestone.

Previous to the sale of the Franklin quarry, the Columbus Iron & Steel Company bought the Wilson tracts of land, aggregating one hundred and thirty-seven acres located farther up the Scioto river. These were sold to

The Marble Cliff Quarries Company in 1921, with the further provision that the company would supply the Columbus works with its supply of limestone at an agreed price. Almost two and a half million tons were taken from this quarry up to 1921 at which time a survey was made showing that there was somewhat more than a million and a quarter tons remaining to be quarried.

The policy of owning its own coal mines and coke ovens was authorized by The Columbus Iron & Steel Company in 1902. Since that time this policy has been persistently followed until in 1921 The American Rolling Mill Company had a total or part interest in four coal properties and a large by-product coke oven plant.

The first step in this field by The Columbus Iron & Steel Company was the purchase of a fifty year lease to run from the first of January, 1903, on the Marting Mine which is a two thousand acre tract of No. 2 gas coal on Smithers Creek in Fayette County, West Virginia.

The Marting mine is a drift mine in a coal seam running about sixty-six inches in thickness. More than two and a half million tons were removed from it between 1903 and 1920, leaving approximately eight hundred thousand tons to be recovered. Below the No. 2 gas seam which is being mined, is the Eagle seam estimated to contain from eight to ten million tons of coal, which is being held in reserve. The capacity of the mine has at times been as high as one thousand tons a day, but by 1921 had decreased to seven hundred tons a day.

Up until 1919 the double bank of eighty-four beehive coke ovens at the Marting Mine was operated. At that time the by-product ovens at Portsmouth owned partly by The American Rolling Mill Company were making shipments, so these beehive ovens were abandoned and partly torn down.

The town of Marting consists of one hundred and twenty-seven dwellings, a store and office building containing a post office, a church, and a school house. The requisite power houses with a tipple contain a storage bin holding five hundred tons of coal. Part of the electric power is purchased and the rest is produced by two generators. The rest of the equipment consists of six electric mine locomotives, eight electric mining machines, and a steam plant of six hundred horsepower.

In 1920 the upper seam of coal in the Marting mine was about worked out and it was found that it would be necessary either to tap the lower Eagle seam or to acquire new property. A committee was appointed to deal with this problem. This committee estimated the requirements of the Middletown, Zanesville, and Columbus plants for the next fifty years and then started an investigation as to how these might be met.

After much investigation the Nellis leasehold of five hundred acres of proved coal land, and about ninety-five hundred acres of undeveloped coal land (Fork Creek Tract) which their own drillings showed to be of great value, was purchased in the summer of 1920, from Messrs. T. E. B. Siler and Mathew Slush. When the property (all in the northern part of Boone County, W. Va.) was taken over there were at Nellis mine nine new dwellings and one boarding house. During 1920, fifty high-grade miner's houses were erected; and in 1921 twenty-five more dwellings. A railroad was extended from the main line of the Brush Creek branch of the C. & O. R. R. up to No. 2 Nellis mine and the first coal was shipped from it on the last day of 1920.

General plans have been prepared for the mining of the whole property, both the Nellis lease and the adjoining Fork Creek lease. A large central tipple is to be erected which will handle all the coal mined in the Nellis lease and will also care for about six hundred acres of the Fork Creek property. The mine plan for the entire tract is based on the double entry pillar and room panel system, using primary and secondary panels. This plan is designed to recover between ninety and ninety-four per cent of the total mineable No. 2 gas coal.

In 1916, the coking facilities at the Marting Mine were found to be both inadequate and expensive so at this time The Columbus Iron & Steel Company took part in the organization of The Portsmouth Solvay Coke Company, Portsmouth, Ohio. This corporation was organized by the Whitaker-Glessner Company, the Semet-Solvay Company, and The Columbus Iron and Steel Company, each company owning one-third; in 1921 Semet-Solvay Company sold its entire holdings in this company to the other two owners and now The American Rolling Mill Company owns half and Whitaker-Glessner Company owns half.

The name has been changed to The Portsmouth By-Product Coke Company.

The ovens of this company are of the Semet-Solvay type in a double block of fifty-four ovens each, making a total of one hundred and eight ovens, each with a capacity of fifteen tons of coal. The by-product plant produces tar, light oil, and ammonium liquor. The other by-products are coke-breeze and surplus coke oven gas. The coke produced is almost wholly blast furnace coke, and the normal output will supply the one big furnace of the Whitaker-Glessner Company and the two Columbus Works furnaces. Some domestic coke is also regularly made and marketed.

The plant was started in December of 1917 under a tremendous handicap. The shortage of coke which was being felt throughout the entire country made it impossible for the two steel companies interested to obtain coke on the open market, so they insisted that the coke ovens be put into operation immediately, although the by-product plants had not been completed and there was neither coal nor coke handling equipment. To make the operation even more difficult the winter of 1918 was one of the most severe in the history of the Scioto valley. The business was operated at a loss during this period but in spite of the handicaps encountered, a sufficient supply of coke was obtained to meet the emergency faced by the controlling companies.

In these ovens a higher quality of coke is made than is customary in coke oven practice. While this extra quality makes a higher cost per ton the furnace practice has shown that it is cheaper in the long run to use this higher quality coke. But this saving in cost is not the greatest advantage which has accrued to the company from owning coke ovens. The greatest benefit was found in the regular supply of coke which made it possible for the Columbus Works to operate, without losing a day, at a time when many blast furnaces were banked for weeks because of the impossibility of securing coke.

In order to be assured of a steady supply of good quality coal for its ovens, The Portsmouth Solvay Coke Company purchased from the Turkey Gap Coal & Coke Company in 1917, the Freeburn coal property in Pike County, Kentucky, consisting of about twenty-six hundred and eighty-one acres of coal land, partly by lease, a little in fee, and

about fifteen hundred acres in mineral rights only. The Freeburn mine is on the west bank of the Tug river opposite the station of Delorme, West Virginia. The property contains three workable seams in which there are about thirteen million tons of recoverable coal.

In 1919, there were five months when the production at Freeburn mine was more than twenty-nine thousand tons of coal a month, so that the total production for the year amounted to almost three hundred and sixty thousand tons. On account of the strike this was reduced in 1920 to about three hundred thousand tons, though at the close of the year production was again in full swing.

The Columbus Iron and Steel Company began to acquire control of its own iron ore mines as early as 1904. All of the purchases it has made have been in the Lake Superior district with one exception. This one exception was the purchase of about eight hundred and fifty acres in Martin County, Indiana, which is underlaid by both iron ore and coal. At the time of purchase it was thought possible to mine these ores, but careful assay proved that neither the coal nor the iron were of a high enough grade to repay for the mining. A part of these lands has since been sold and the company retains the title to a little more than six hundred acres.

As in the development of its coal properties, The Columbus Iron & Steel Company in acquiring its iron ore rights pursued the policy, later followed by The American Rolling Mill Company, of participating in the organization and ownership of subsidiary companies. The first of these to be organized was The Castile Mining Company, which was organized in 1904 by Oglebay Norton & Company, Cleveland, Wheeling Iron & Steel Company, and The Columbus Iron & Steel Company, the last named owning one-fourth interest and the other two each having a three-eighths interest.

The Castile Mining Company has opened up three profitable mines on its property. These are known as the Eureka, the Asteroid, and the Castile. The ore produced by The Castile Mining Company is mined by the slicing and caving system, shipped to Ashland, Wisconsin, by rail, thence by boat to lower lake ports.

The same year The Columbus Iron & Steel Company became interested in The Consumers Ore Company. This company was organized by M. A. Hanna & Company,

The Rochester & Pittsburgh Coal & Iron Company, and The Columbus Iron & Steel Company, each owning a one-third interest. They acquired four properties on the Mesaba Range, and opened up at different intervals the "Yates," "Frantz," "Hanna No. 1" and "Hanna No. 2" mines. At the same time The Consumers Ore Company acquired a lease on the properties of The Richmond Iron Company, which was a large siliceous iron ore mine in the Marquette district. Later a separate organization was formed to take over this property, which was operated under the name of The Richmond Iron Company, the stockholders being the same as in The Consumers Ore Company.

The properties owned by The Consumers Ore Company have been operated continuously since 1904, and practically all these properties are now exhausted, with the exception of the Frantz Mine, which has sufficient ore remaining to justify its operation for three or four years.

The Richmond Mine is a very large property, and has ample reserves so that it will be operated to at least the end of the present lease.

In 1906, The Columbus Iron & Steel Company, in connection with Oglebay, Norton & Company, The Wheeling Steel & Iron Company, and A. M. Byers & Company organized The Fort Henry Mining Company, and purchased from The Algoma Steel Company a property on the Mesaba Range known as the "Woodbridge Mine." This property has been operated continuously from the time it was acquired until November, 1921, at which time all the high grade ore had been taken out, and the property was abandoned, and the lease reverted to the State of Minnesota.

The next mining venture undertaken by The Columbus Iron & Steel Company was made in 1912, when, in connection with Oglebay, Norton & Company, of Cleveland, it organized The Fortune Lake Mining Company, and took one-third of its capital stock. The properties of this company lie on the Menominee Range in Iron County, Michigan.

In 1917, The American Rolling Mill Company participated in the organization of the Hanna Ore Mining Company, a Minnesota corporation. In the beginning eleven iron and steel companies were interested in this

project, but from time to time some of the holders have merged, until by 1920 the membership in the corporation had been reduced to seven. The interest of The American Rolling Mill Company then amounted to seven and a half per cent.

During the year succeeding its organization, the Hanna Ore Mining Company purchased from the Great Northern Ore Company properties containing in all ten mines located with one exception in St. Louis County, Minnesota. A little later three other mines in the same county were acquired from other parties. Of these all but three were producing in 1920, the ones not yet developed being the Missabe Chief which is located in Itasca County, the Enterprise and the Wabigon.

From these mines only one grade of ore is shipped, that being known as "Hanna." The estimated reserves in the thirteen mines owned by the company on July 1, 1917, was more than thirty million tons, all of which according to the agreement, must be exhausted by December 31, 1956. From this property alone the Columbus Works is entitled to draw ninety thousand tons of ore a year until the lease expires, this being approximately one-fourth of their total ore requirements.

The oldest of the mines is the Leonard, which was opened in 1903. The next mines to be opened were the Brunt and the Hobart. the former being an open pit mine with a maximum vertical depth of one hundred ten feet, and the latter being an underground mine. They were opened in 1906.

Three mines were opened in 1910, the Harold and North Uno Mine G. N., which are worked by underground methods and the South Uno Mine G. N., which is worked by the open pit method. In 1914, the Throne Mine was opened and worked by underground methods, the greatest vertical depth being ninety-five feet. And the last mine to be opened prior to 1920 was the Pilot, which was opened in 1917 and is worked by underground methods, the greatest depth being seventy feet.

By its holdings in these various companies, The American Rolling Mill Company placed itself in a very strong and satisfactory condition in regard to ore reserves, as its share of the "assured ore" and "probable ore" compares very favorably with the total known and the probable reserves of the Lake Superior region. The per-

centage which the blast furnace capacity at Columbus bears to the blast furnace capacity of the entire country has such a relation to the company's control of ore reserves, as to assure an adequate supply far into the future.

Not only did it gain control of its own coal and iron mines, but The American Rolling Mill Company found it advisable to control its own transportation facilities on the Great Lakes. In 1914, The Columbus Iron & Steel Company became interested in The Fort Henry Transit Company and the Castile Transit Company, each of which was operating one boat to carry the ore of a particular mine.

These two boats were under the management of one of the oldest operators on the lakes, who also managed the boats of six or seven other companies, each of which owned a single boat. This arrangement was neither economical nor elastic, so in January of 1921, ten steamship companies consolidated their holdings and organized into The Columbia Steamship Company.

The company thus formed owned after its organization eleven boats with a total carrying capacity of a little more than eighty-nine thousand tons. If they were all placed in line, touching each other at stem and stern, these eleven boats would reach almost exactly one mile.

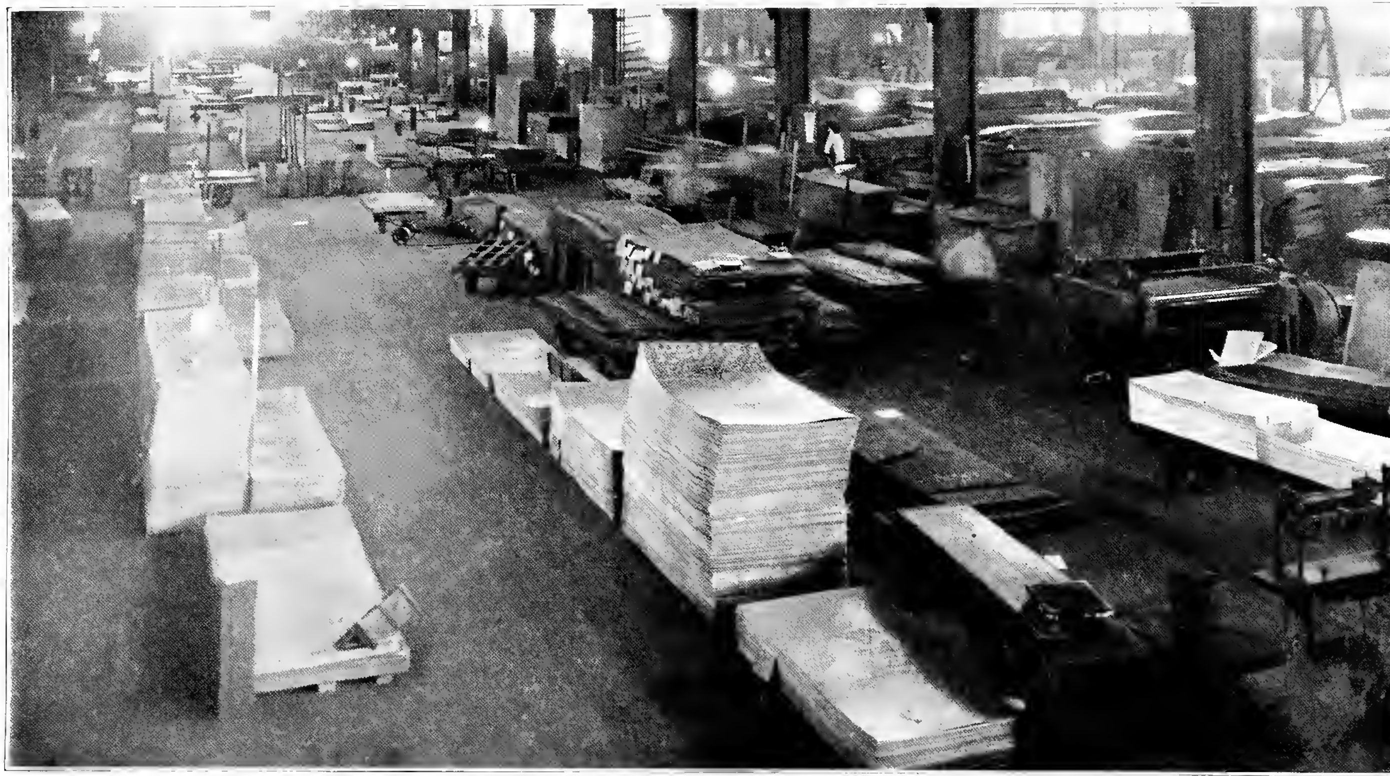
In 1910, The Columbus Iron & Steel Company became interested in the North American Steamship line which was just being organized at that time. Although not controlling a majority of the stock the Columbus company was enabled to have the use of all the facilities of the company as fully as though possessed of a controlling interest. This company built two boats in 1910, the Peter Reiss and the A. M. Byers.

In the year 1913 three more boats were purchased by the North American Steamship Company, two of which were of antiquated design and were promptly disposed of when the great demand for tonnage came during the war. This left the North American Steamship Company with three boats which they operated until 1920, when they merged with The Reiss Steamship Company of Duluth.

At this time the control of the entire company was taken over by Mr. Peter Reiss, a coal operator with docks at Sheboyan, Greenbay, Duluth, and Ashland, who alone is able to furnish the boats with all the coal they can

transport on the up-trip. The A. M. Byers Company and The American Rolling Mill Company, who are both interested in The Reiss Steamship Company, are both shippers of ore and, with some outside connections, are able to supply the boats with all the ore tonnage they require. This plan assures a low cost of operation and a fair margin of profit on the fleet of eight ships, the combined capacity being sixty-seven thousand tons.

In the first twenty years of the history of the Blast Furnace Division of The American Rolling Mill Company, this sturdy blast furnace company reached out for the control of its raw materials, gradually acquired coal and iron mines, limestone quarries, and transportation facilities until it had obtained the greatest efficiency possible along these lines. One management controls every phase of the operation from the raw material in the earth to the finished product ready for manufacture or immediate use.



East end Warehouse at East Side Works in 1920

Chapter VI

Twenty Years of Progress of Galvanizing

Old Galvanizing Shop—Equipment and Methods—Unannealed Sheets—Installation of Gas—Cast Iron Equipment replaced by Ingot Iron—Order System—Galvanizing Ingot Iron—Improvement of Equipment—East Side Works Galvanizing Department—Closing of Central Works Galvanizing Department—Tight Coated Sheets—Alloy Coating—Building of New Shop at East Side—Improvements in Practice.

WHEN The American Rolling Mill Company decided to build a galvanizing department a new example was given of the pioneering spirit which characterized the founders of the company. Up to that time galvanizers had bought Bessemer sheets almost exclusively and had failed in some instances where they had attempted to galvanize open hearth sheets. Armco, however, never had any unsurmountable difficulty in putting a heavy coat of closely adherring spelter on open hearth sheets.

On February 24, 1901, some days after the first heat was tapped the first galvanized sheet was coated at Armco. The original galvanizing shop at Central Works was located on the south side of the driveway back of the time office where the culvert department has since been installed. A depressed track ran between the machine shop and the galvanizing department.

The galvanizing department building was constructed of brick, and the pickling room was a low roofed, wooden lean-to on the north side. Operations were started when only one galvanizing pot was ready for use but in the course of the first year two hand-fed galvanizing pots and two hand-operated picklers were installed. The hand-dipped pots were operated by belt driven machinery which was driven by a small steam engine in the galvanizing room, the steam for which was delivered from the main boiler house. Covered pipes were unknown at Armco in those days so by the time the steam reached the engine it was often half water. The belts themselves were affected by the fumes and were continually giving trouble.

For the first six years the pots were heated by coke and were so built in sections that a separate fire box was

tended from each side of the pot. As long as coke was used as a fuel there were no stacks to the pots and an opening was left around the edge of the pot to gain the necessary draft. Nor were there any cast steel cover plates on the top of the fire boxes. The pots were painted white when built, though of course they did not stay that color for any length of time.

It was a far cry from the early method of bringing the sheets to the galvanizing shop to that used today. The sheets were loaded on hand trucks which were hauled onto a hand car that ran on a depressed track from the sheet mill and annealing department to the galvanizing department. This car was pushed opposite the door where it was desired to unload the sheets and the hand truck was run off into the building.

In part the severe conditions under which the men had to labor in the first years of the galvanizing shop's history were due to the fact that galvanizing itself was in its infancy and such appliances as are in use today had not been perfected, and in part they were due to the policy so prevalent everywhere in those days of giving little thought to the improvement of working conditions. In the pickling room the low roof, the lack of ventilation, and the fact that all pickling had to be done by hand made it difficult to get men to work in the department. During the early years the labor turnover often ran as high as fifty per cent a week. In winter the galvanizing room sometimes grew so cold that the men wore overcoats while feeding the pots and icicles froze on the rolls through which the sheets were fed.

The sheets were fed into gum rolls by hand. A man stood between the two pots to govern the exit rolls. After the sheets had cooled two men picked them up and fed them into the leveler. As the sheets came from the leveler two men marked them and piled them on trucks to be bundled and hauled to the stock room. All of this work was done by hand because, with the exception of an old derrick in the center of the room which took the place of a crane, there were for several years no mechanical devices to reduce labor.

With the old coke-fired pots, a great deal of difficulty was experienced in keeping the spelter hot enough for galvanizing. On a lot of a hundred thousand 20-36-120 sheets, thirty-six was the highest number of sheets run consecutively without freezing up the pot. When the pots froze the men on the crew lay down and went to sleep until the pots

heated up again. Salammoniac was thrown on the rolls to determine whether or not they were hot enough.

The flux boxes were made of cast iron and rarely lasted more than a week and occasionally as many as three were used in that length of time. Later "Armco" ingot iron boxes which lasted eighteen months were installed. The exit rolls were equipped with cast iron gears which did not have nearly enough strength to withstand the strains put upon them when a pot froze or an extra heavy lot of sheets was run so that gear stripping caused a great deal of trouble. The gears also dissolved very readily in the spelter so that their average life was rarely more than one week. After the development of Ingot Iron the gears were made from this metal and were found to last on the average about three months or twelve times as long as cast iron gears.

Only occasionally was any galvanizing done for a special order. Each week the sales department instructed the galvanizing superintendent what to produce. The sheets were galvanized in stock sizes and weights and orders were filled from stock, the superintendent of the galvanizing department being responsible for the shipment of his own product.

The life of a foreman in those days was not one of unalloyed bliss. Almost always he had to manage a green crew who knew little about its work and he was continually confronted with difficult problems of both production and management. The crew in those days consisted of about thirty men on each shift working eleven and thirteen hour turns. The foreman served as timekeeper for the shop, keeping the record on a large sheet on a board with pegs where the men left their checks on going in and coming out of the shop.

Because of the practice of galvanizing unannealed sheets in those first years a great deal of difficulty was experienced due to the stiffness of the sheets and their unmanageable characteristics. In some cases a man reached over the exit rolls and pushed them down in order to keep them from doubling back around the rolls into the spelter. Another method of meeting this difficulty was to allow the sheets to overlap as they went through the rolls.

The first big improvement came in February, 1907, when gas was installed in the pots. But gas brought its problems. The coke furnaces without flues were not suited to the use of gas and until alterations were made in the design of the pots, trouble with their freezing up or getting

so hot that even the flux burned up, was a common occurrence. With the introduction of gas for heating the pots, flues had to be installed. These were at first built of brick and filled quickly with scale and waste of various sorts, in one case to the depth of eight feet. Every year the stacks had to be dug out and finally a loose place was left in the base of each stack to make it easy of access for cleaning.

The first Ingot Iron was galvanized in 1907 and the usual difficulties attendant upon the treatment of a new substance were encountered. These difficulties however were overcome with the discovery that Ingot Iron required a longer time for pickling or else a much hotter temperature in pickling in order to prepare it to take on a good coat of spelter. This was due to its superior resistance to acids as compared with steel. The higher temperature at which this pickling was done made the fumes in the old pickling room even more disagreeable than before. Wheat bran on top of the pickling tanks was used to reduce the fumes and was found very effective. Once the peculiarities of this new product which Armco had perfected were understood, the galvanizing department found Ingot Iron no less difficult to coat than steel although it required a higher temperature and longer pickling. The uniformity of Ingot Iron sheets permited much more uniform practice than was obtainable with steel sheets.

Beginning with the year 1907 a steady improvement was made in the galvanizing equipment. In that year two machine-fed pots were built in addition to the two hand-fed pots which had been in the shop since the first year of its operation. A little later four machines were built, but great difficulty was experienced in getting enough room for the machinery on account of the narrowness of the shop. In 1910 the company installed a ten ton crane which greatly lightened the work and speeded up production. A plunger type of pickler in the center of the shop supplanted the hand-dip methods which up to that time had been used in pickling. However, the location of the pickler in the center of the shop, away from ventilation, made the fumes from the acid very bad.

Scientific control of galvanizing was a long time in development. The acid was not tested at all until 1907 and not until 1911 was a full system of chemical control of spelter and acid developed. Spelter was often dumped into the pot ten bars at one time. Even the heat of the pot

was for a long time subject to variation without the knowledge of the crew, for it was not until 1914 that pyrometers were installed to accurately register the pot temperature.

From time to time various changes have been made in the method of handling the rolls. At first they were shoved into place from the end and fitted very snugly. Later practice leaves them a quarter of an inch loose. Heavy "gum rolls" coated with rubber were used to dry the sheets as they came from the acid. These rolls were coated in Akron and were both expensive and troublesome, so finally they were discarded and replaced by Ingot Iron rolls which served the purpose very effectually.

At first it had been difficult to run heavy gauge sheets on the hand-fed pots, but after the introduction of the machine-fed pots difficulty was experienced in running light gauge sheets because of their tendency to curl up on the rolls.

When the East Side Works were first planned there was no intention to install a galvanizing department because it was felt that the four pots at Central Works had ample capacity to finish all the sheets which would be needed. However, late in 1910 when the possibilities of the new plant became clearer a galvanizing department was started at the East Side Works. The pickler at the East Side began operations on the 7th of October 1911, and the first pot started on the first of November of that year. The original equipment consisted of four machine-operated pots and one Mesta pickler.

In 1913 the most severe flood in the history of the city swept through the Central Works, leaving ruin in its wake. The Central Works galvanizing department never reopened. Instead two more pots were built at the East Side and all the galvanizing work was transferred to that plant. A seventh pot was installed about one year later.

From time to time improvements were made in the new shop. In 1915 a motor drive was put on the pickler and a storage battery locomotive was purchased. In the same year a pot was built to coat sheets with an alloy of lead and tin.

In 1912 a new lightly coated sheet was devised. This sheet was run in through lead and out through spelter giving it a very light and closely adherent coat. This practice was continued where a sheet of this nature was desired. In 1915 spelter grew so expensive that one pot was given over to coating sheets with an alloy composed of

lead and tin. These sheets proved so satisfactory that the practice was continued.

In 1919 when a five million dollar addition was made to the East Side Works a new galvanizing shop was included in the specifications. It was completed in the fall of 1920 and was operated during the last three months of that year. The new shop is equipped with seven spelter and one alloy pot, a Mesta steam pickler with a special turning device, storage battery locomotive, and a forty ton crane. In this shop, as in the previous East Side shop, the pickler is in a separate room which is well ventilated. The hoods over the galvanizing pots are also of late design and serve very effectually to carry away the major portion of the fumes so that the galvanizing department is now a pleasant place to work.

In the growth of the sheet metal industry, for many years there was a race between the capacity of a sheet mill and the capacity of a galvanizing pot. At last the galvanizing pot won, and now a light-gauge pot can galvanize the sheets from two light-gauge sheet mills. In 1905 and 1906 the tonnage per pot-hour was two thousand seventeen pounds. At the end of the next five years this figure has increased to thirty-four hundred ninety pounds. By 1915 the production per pot-hour had climbed to forty-four hundred pounds, and in 1920 fifty-three hundred pounds per pot-hour was galvanized, this being a gain of more than two hundred and fifty per cent in fifteen years. In the same time the facilities of the plant had so increased that the yearly tonnage had increased a thousand per cent, rising from seventy-five hundred tons in 1905 to seventy-five thousand, eight hundred tons in 1920, fifty thousand tons of this increase in annual capacity having come within the previous five years. The pickling process also grew more efficient as time passed. In the fiscal year of 1911-1912 its average production was seventy-five hundred pounds per hour. This figure by the year of 1920-1921 had increased to thirty-one thousand pounds per hour.

Ten years were required to decide on scientific control of galvanizing, five years were necessary to install it, and five years were required to perfect it. But at the end of its first twenty years of operation the galvanizing department has reached a sound scientific basis where quality and quantity production go hand-in-hand under efficient management and operation.

Chapter VII

The Developement of An Electrical Sheet

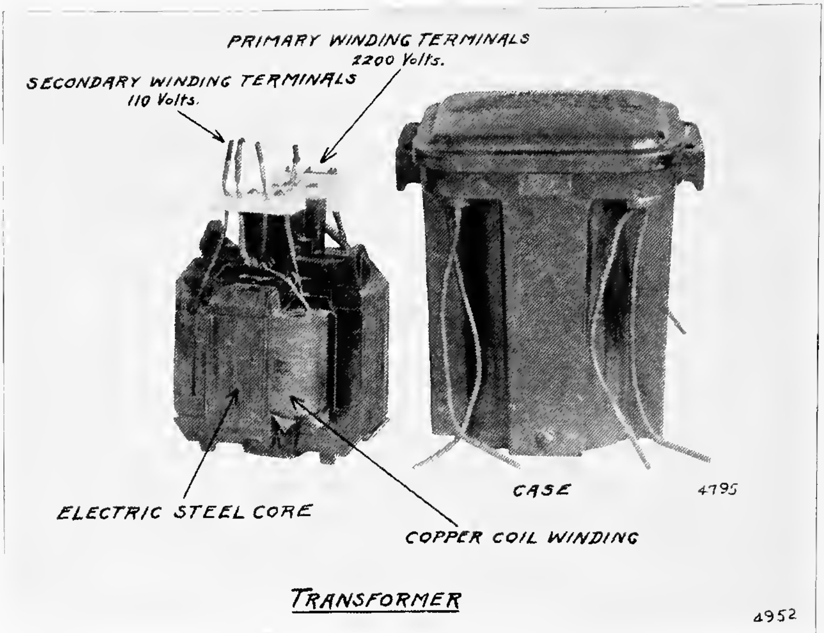
The Need of Special Sheets for Motors, Generators and Transformers—Experiments at Armco—Difficulties Encountered—Installation of Research Work—Transformers, Generators and Dynamos made of Armco Electrical Steel—Laboratory Testing Machines.

WITHOUT steel or iron there could be no electrical machinery. Every dynamo, motor or transformer requires metal in some form in order to produce the magnetism necessary for the generation of electricity.

An electrical generator is a machine for converting energy in the form of mechanical power, such as supplied by steam engine, into energy in the form of electric currents This definition covers all machines, the action of which is dependent on the principles of magneto electric induction discovered by Faraday in 1831.

Fifty years ago the dynamo first came into general use as a power in the commercial field and the development of electrical machinery since that time is unquestionably one of the greatest triumphs of the age. No machine is too large, no instrument too small, but that electricity can play its part economically and efficiently in its operation. From the heavy train that crosses the Rocky Mountains, down to the modest vacuum cleaner or electric fan in the home, then further on to the delicate instruments of science, electricity is performing its daily task. The development which has taken place in its use during the past half century only shows what may be expected in the future. It has literally become the hand servant of man and must needs take its place in every household and in every walk of life.

While the magnetic properties of iron and steel have been known for a great many years, it is only since the year 1880 that iron and steel have been used in sheet form in large dynamos and motors. The early dynamos were those of the permanent magnet type where the rotary part and the stationary part were each a solid forging. These machines had very narrow limitations.



TRANSFORMER

4952

The next step was the use of cast iron in the frame or pole pieces and of sheet metal in the armature or rotating part. It was found that by building up the armature with sheets that the heating effect, caused by the magnetic friction, was much reduced. This was also found successful in the development of the alternating current apparatus for transforming electric currents of high voltage to low voltage and vice versa.

About 1888 a large manufacturer of electrical machinery, believing that the use of laminated sheets for transformer cores was unnecessary and that cast iron might serve as well, put their ideas to test. The result was unsatisfactory, for the cast iron cores became red hot, burned the insulation, and destroyed the transformer. Since that time solid sections have not been used in those parts of electrical machinery subjected to magnetic friction and so far as known nothing will successfully replace electrical sheet steel or iron for this purpose.

Early in the progress of the work when the importance of laminated iron and steel sheets became known, another problem presented itself. No mill was at this time was specializing on electrical sheets; the manufacturers of steel sheets knew practically nothing about the magnetic requirements.

The method of purchase was on the basis of a common commodity sheet, with all the sins of non-uniformity included, and the ultimate price of the sheet was regulated by the quality as proved on test by the electric company. Most of the sheets furnished were of Bessemer steel.

It was now apparent that uniformity was essential before a high quality electrical sheet could be manufactured; and the manufacturer of electrical apparatus believed that a closer connection with the mills making steel sheets offered the only solution to the problem.

Following negotiations in the fall of 1902 one of the largest manufacturers of electrical machinery accepted an opportunity to work out its problem with The American Rolling Mill Company, and arrangements were made to purchase an entire heat of steel that should be made under their direction at Middletown.

In May 1903, the first heat of electrical steel was made in Middletown. One of the most important requirements was that the steel should be low in sulphur and phosphorus and that the carbon should be at such a point that by careful annealing the finished sheet would analyze under .08. The manganese specification was placed at .35 to .50. This was the first attempt to secure uniformity in electrical steel, and it was agreed that clean scrap and pig iron were the necessary basis for such a material.

The heat was charged about noon and tapped about 1:00 a.m. When the heat was ready to tap, the telephone rang in a little bed room over the general office, where the superintendent—who was at the plant twenty-four hours a day—could always be found. "Quick!" called the voice at the other end of the wire, "don't stop to take off your night shirt, pull on your breeches and get down here in a hurry or we'll lose the heat."

All went well from a pouring standpoint and the ingots (bottom poured), size 8 inches by 10 inches, were charged into the bar mill furnace and were ready to roll about 7 a.m. The rolling of the ingots into bars was accomplished without difficulty. The bars were then taken to the sheet mill where they were rolled and delivered to the annealing furnace.

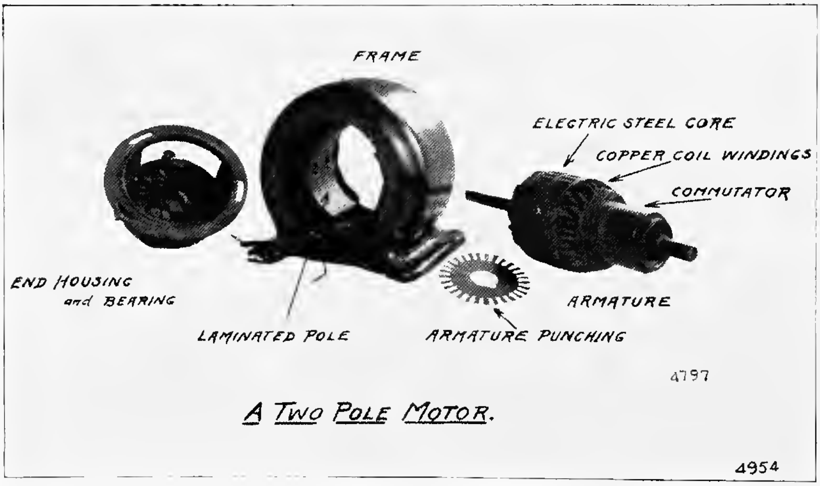
On June 4, the first car of electrical sheets made from this heat was shipped and put through the usual test. The result of the experiment was very encouraging and it was agreed that further work should be done at the mills.

On July 1, 1903, The American Rolling Mill Company put in a special department for the further development of electrical steel sheets, giving special attention to the uniformity of the product. The analysis and selection of raw materials were made matters of first consideration, metal was tapped on carbon and manganese content, and bars and sheets were rolled and annealed under pyrometer temperature control.

Producer gas was then used as fuel and this, together with an inferior grade of coal, made it difficult to keep the sulphur within the required limits. This necessitated care in coal selection and investigations of the use of other fuels.

As the development progressed the uniformity requirements of the electrical machinery manufacturer were being well served, so other grades of electrical sheets were ordered to meet new needs in the development of their product. Among other things there was a great demand for improvement in sheet steel for transformer purposes, and experiments were begun with this in view. A clue was obtained from various sources which seemed to show that ferro-silicon would help the magnetic properties of steel.

The adding of a silicon content presented a problem not yet encountered in open hearth practice. It was found that the silicon could not be successfully added in a furnace, the lining of which was basic. On the other hand, if the required quantity of silicon was placed in the ladle before the heat was tapped, the molten metal became ex-



A TWO POLE MOTOR.

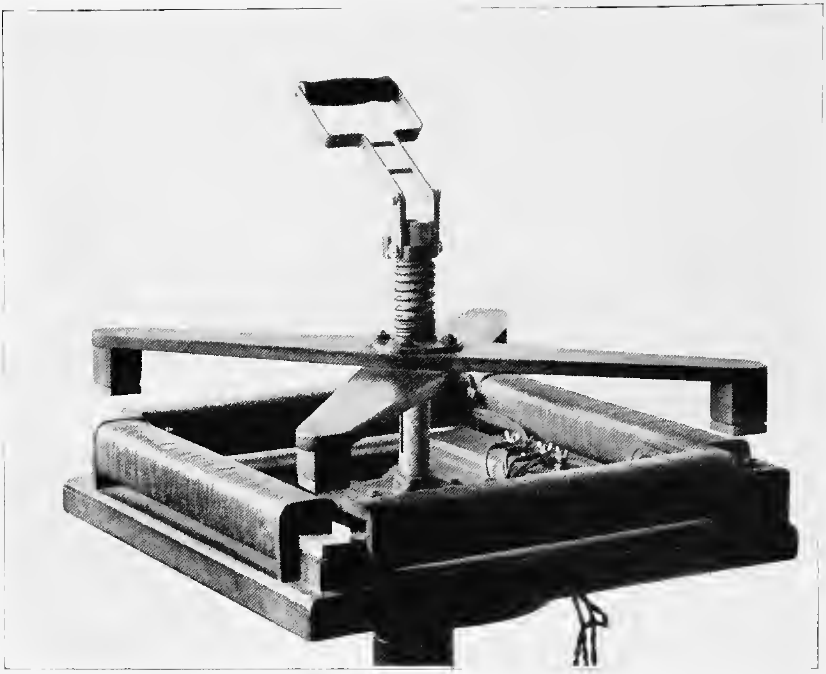
cessively hot. On several occasions the metal bored its way through the bottom of the ladle and the heat was lost. To further complicate matters, it was found that ferro-silicon added in the molds produced a non-uniform ingot. Notwithstanding these difficulties it was decided to continue the experiments in the molds to determine physical characteristics, as this presented the most inexpensive and least dangerous method.

In the early days of this electrical sheet steel development, the open hearth practice at Middletown was to cast small ingots, bottom poured, approximately one hundred and fifty ingots to each heat. Their weight was around 600 lbs. each, and their cross section 8 inches by 10 inches. The stripping was done by a small crane assisted by "pit" men whose duty it was to place the hooks. With ordinary steel it was possible to cool the ingots with water before carrying them to the reheating furnace, but in the case of silicon steel it was found that water cracked the ingots. The result was that the ingots had to be air cooled thus adding greatly to both labor and time used in their production. In the reheating of these ingots a number were often lost due to the strains set up in the coarse grained material.

The next step, which was the rolling of these high silicon ingots into the bars, required much care. It differed from ordinary steel practice in that the bars had to be handled hot instead of passing through a tank of water, which served as a cooling device. Hand trucks were used to carry the hot bars into the yard for cooling before delivery to the sheet mill. The red oxide which appeared on these bars and the difficulty encountered in rolling them, gave them the name of "red devil."

These difficulties had a disorganizing effect on the men because their tonnage was cut, and, even after the bars were received they were of such varying dimensions as to discourage production. They could not figure on a regular output.

In order to meet this condition, the company, at great expense, guaranteed definite tonnages to men, but even this did not take away the discouraging feature. In the rolling of the bars, the nature of the steel and the limitations of power were such that they had to be rolled very hot. This often resulted in "collars"—bars curled around the roll—and the only way to remove a collar was by



Testing Core—Epstein Core Loss Tests

chisel and sledge or by changing the rolls, which required several hours' loss of time.

This condition happened as often as twice a day. The lack of facilities for the work was a constant handicap. Insufficient space for rolling bars that proved to be extra long because they were made from ingots that might be only a few pounds heavier, extended the ribbon of red hot metal to such a length that it would strike the shears and buckle in the air.

If the shearman could not take care of it because of either a breakdown of the shears or the lack of men to straighten the bar before it cooled, it had to be broken up by sledges and carried away to the scrap pile. This difficulty was chargeable entirely to the composition of the electrical steel, as ordinary steel could have been handled cold with very little loss.

In regular mill practice a standard conveyor carried the bars from the shears through a tank of water for cooling purposes. It was soon found that any water striking the surface of a hot silicon steel bar would cause it to crack.

It was therefore necessary to eliminate the water cooling and handle the bars hot.

What happened to the conveyor under these conditions was a tragedy to the operating department. The heat of the bars buckled the conveyor plates so it would not run satisfactorily and was a constant source of expense and trouble. But after much expense the difficulty was finally overcome and a conveyor designed that could carry the hot bars without prolonged shut downs.

Whatever progress The American Rolling Mill Company has made in the development of electrical sheets has been no accident. It was a struggle of the first magnitude. Without the intense loyalty of the men of the organization who backed the management in this most critical period, little could have been accomplished. Hard work and painstaking effort have brought their own reward. The close cooperative arrangement between the manufacturer of electrical apparatus and The American Rolling Mill Company has also been a real source of inspiration and has unquestionably worked to the advantage of both concerns.

The complete apparatus for the testing and advancement of electrical sheet industry has long been an important part of the research laboratory at Middletown, where all processes of the work are carefully followed and checked from the raw material to the finished test of the electrical machinery in accordance with American Rolling Mill Company standards.

Pouring an Experimental Heat of 40 Pounds in the Research Laboratory

Chapter VIII

Development of High Finished Sheets

Early Experiments—Bow Socket Steel—Auto Body Stock—"Armco" Polished—Meeting the Demand for Deep Drawing—Solving the Radiator Casing Problem—Inspection Department Taken Over by Operating Department—Following up Customer's Requirements—Attempt at Efficiency Methods in Finishing Processes.

BACK in 1906 Armco was making steel sheets which had a very high phosphorus and comparatively low manganese content. But for special drawing purposes a grade of steel was made very similar to the present "H" which was low in phosphorus and .04 or higher in manganese. This was known as "DS" or "Deep Stamping."

There had been no special attention given to annealing or finishing sheets for special purposes. It was in this same year that Armco made its first pickled sheets. They were intended for pressed steel steam radiators. The sheet was 20 gauge and as much care as possible was given this order on the hot mills to keep it clean and smooth. The sheets were sent to the galvanizing shop for pickling where every precaution was taken to have these sheets come out clean and well annealed. The first boxes of sheets were badly stained, due to their having stood around wet between the pickling and annealing.

Numerous experiments were made and the best results were obtained by partly drying the sheets on the gum rolls in the galvanizing shop and using a short, hot firing in the annealing. It was slow laborious work.

Sheets obtained in this way had a very handsome appearance but gave a great deal of trouble due to sticking. It required several days to strip sheets after annealing and the sheets were often badly bent and some of them ruined in this manner. After a time the effort was abandoned and it became the first item in the price Armco paid for experience, in the manufacture of specialty sheets.

Armco's first attempt at a highly cold rolled pickled specialty, was Bow Socket Steel, for a concern at Cortland, N. Y., in 1907. These sheets were in 24 gauge and of a rather large awkward size. Saddle blocks were put on

the cold rolls and the resultant sheets were very beautiful to look at, but the results to the customer were not altogether satisfactory, for the sheets broke in double seaming. About this time, however, the sheet mill began to make much larger tonnages, so that the cold roll equipment was taxed to keep up in ordinary one pass orders, and no longer had capacity to experiment with fancy cold rolling.

About 1910 Armco began experimenting with sheets for auto bodies. In the light of the present day these auto sheets would be curiosities as they were merely unpickled, deoxidized, lightly cold rolled sheets, afterwards known as "Armco Grey Smooth."

Armco's first customer for these sheets was the Racine Manufacturing Company. Their order required sand blasting and a great many coats of paint in finishing and the practice of making sheets of this character was continued in a small way for some time.

In the meantime the automobile manufacturers were growing very rapidly and were carrying on experiments in the use of sheets for their purposes in conjunction with some of the sheet and tin mills which had established reputations for the quality of their fancy cold rolled products. Their object was to obtain a surface on their sheets which would reduce the painting operation to a minimum.

In 1912 Armco started to make automobile sheets in earnest and for this purpose installed a pickler for sheets and a train of cold rolls especially for high finished sheets. Experiments were made with double pickling and a grade of steel which did not require bar pickling was adopted. This grade was called "DS," altho it was quite different from the former grade of the same name.

This grade of steel for auto sheets was used until a bar pickler was installed. The first experience with sheets

Automobile Fender Drawn from Armco Steel

for dipped enameling came when the company undertook to make fender stock for the Chalmers Motor Car Company, which was followed very closely by an order for fender stock from the Cadillac Company. The experience with the Cadillac Company was exceedingly satisfactory from an operating standpoint, because they knew exactly what they wanted for their enameling process.

These sheets for dipped enameling required a much sounder surface than Armco had ever put on sheets before. This quality was obtained by means of special cold rolling, the sheets being given many extra passes on the cold rolls. This excessive cold rolling was necessary, because at that time no one knew how to make a sheet with a good enough hot rolled surface so that it could be finished with a reasonable amount of cold rolling.

For a considerable time after Armco started making auto sheets in earnest, all the sheets for this purpose were "silver finished" and resquared. This was a standard which the sales department insisted upon because they believed it added distinction to Armco sheets. Both these practices, however, have since been dropped except in a few cases where the customer requires them.

The resquaring, especially, at one time was a serious problem. Shears were placed in every available space, working double turns, and yet were not able to keep up the resquaring on the growing tonnage. Intensive study and a bonus system for the shearmen managed finally to keep the shears about half a jump ahead of the tonnage until the practice of resquaring auto sheets was finally abandoned.

As more and more draws began to be made by the automobile manufacturers, it was found that the "DS" grade of steel could not meet the demand from a draw standpoint. Armco therefore, in the Summer of 1913, installed equipment for pickling bars so that bars of ordinary analysis could be used. But this change from pickled to unpickled bars caused much trouble on the hot mills which Armco has been busy solving ever since.

One serious hot mill trouble which had to be overcome was the tendency of the pickled bars to quickly roughen the hot mill rolls. Great difficulty was also experienced in rolling long, wide packs, due to the low temperature at which the pickled bars must be heated.

To solve the difficulty experiments were made with a grade of steel called "RB" which was adopted as an experi-

ment for lessening the trouble with wide, long packs on the hot mills. This "RB" grade of steel was much softer than ordinary mild steel and contained high phosphorus to prevent sticking. However, it was not very satisfactory from either a surface or a drawing standpoint and was later abandoned as the Armco organization became more skillful in rolling steel in long, wide packs.

One of the first serious difficulties with meeting the demand for drawing purposes was in connection with radiator casings. The earlier models were a simple draw and could be made from almost any sheet. All the manufacturers suddenly changed their model so that the casings had to be drawn, then expanded, and in this process Armco's troubles began. Even if the sheets successfully stood the two operations they were so badly strained and crystalized that the casings were likely to snap in subsequent handling. The emergency was met with a lot of experimenting which finally evolved a sheet that was satisfactory.

From the foregoing it will be seen that Armco's early experience in making sheets for drawing auto parts was a series of desperate emergencies similar to the experience with the radiator cases, and these emergencies had often to be met by desperate expedients. There was a time when Armco was making auto sheets by so many different treatments that it was almost impossible to keep track of them. In time, with a better understanding of the customer's requirements, the different grades and treatments were standardized so that for several years past Armco has seldom found it necessary to make anything special to meet its customer's requirements, no matter how severe these may be.

Increasing the severity of draws, in addition to changing the grades of steel, early suggested a very close investigation of the heat treatment of sheets for drawing purposes. A committee was formed under the direction of the research department of The American Rolling Mill Company to study the problem. Extensive experiments and investigations were carried out and the results were applied to Armco practice as rapidly as possible.

At the same time it was decided that the operating department should know more about the requirements of individual customers, especially as regards the different conditions existing in different plants. A member of the

operating department was detailed to work in conjunction with the inspection department for this work and a great amount of time was spent in customer's plants. As a result of this intensive study Armco was able to satisfy the demands of its customers to a much greater extent and consequently to give them better service.

Later the inspection department was taken over by the operating department, which is still continuing this work of following up customers' requirements. At the end of this two years study a policy was adopted by the operating department of furnishing Armco customers what they needed, working closely with the sales department. This could be done only by scrutinizing closely each order sent to the mill and by giving these orders one of the standard routings which had been worked out from past experiences.

During these two years of investigation, a great many experiments were tried which developed a standard routing by grade. But few changes have been made in these routings in the three years since they were established and most of these have been due to the demand for increased production and better average quality.

As early as 1916 or 1917 Armco started special finish sheets for stove purposes under the term "Polished." The first attempt was to make a steam blued sheet. Many sheets with a handsome blue color were made, but in doing so a very peculiar trouble was encountered. It was found impossible to put a steamed blue oxide which would stick on "Armco" ingot iron nor has it been done to this day, altho a considerable tonnage of steam blued steel sheets has been produced without any difficulty in making the oxide stick. The surface of these early sheets was also quite unsatisfactory.

At the time the new East Side Works was being contemplated the question of a special department for making high grade sheets was considered. The company even went so far as to make an investigation and draw up plans for such a department, but the idea was finally abandoned.

The history of the development of an Armco polished stove sheet is principally concerned with producing the right color and quality of oxide on the sheet. It was found that a very slight variation in practice makes a decided difference in the oxide coating. The progress which has been made during these years has been toward improv-

ing the uniformity of the process in order to put it on a better commercial basis.

The development of these processes for making high finished sheets was accomplished for the most part during periods when Armco was under tremendous pressure for tonnage and it was necessary to make changes in machines, methods of handling, and recombination of processes, at the same time increasing the amount of tonnage going through the mills.

It would require a poet to do justice to the story of the pickling and drying apparatus. Originally designed and built as an experimental machine, it suddenly became a vital link in our chain of operations. The annealing department organization, upon whom it was thrown, was immediately up against a nightmare made up of every conceivable kind of breakdown, combined with inexperienced crews and an apparently hopeless congestion of material. Then as fast as they were able to fix conditions to nearly take care of this tonnage, the tonnage was promptly boosted and the same process had to be gone through again and again.

The original sheet pickler, for instance, with difficulty turned out two tons per hour. Its tonnage has gradually been worked up to the present sustained average of about ten tons per hour.

In fact some of Armco's first attempts at "efficiency methods" were made in these finishing processes. For example, it was found that the cold rolls were putting through only 20% of the surface speed of the rolls. This was increased to more than 50% by the use of conveyors on the mills and a production bonus for the crews. Similar methods were applied to the sheet pickler, resquaring shears and bar pickler.

An attempt was made to increase the capacity of the cold rolls by grinding and polishing the rolls in a machine made for this purpose instead of in the housings, but this practice was dropped because the specially ground rolls did not turn out sheets of required finish.

The increase of mill equipment for the manufacture of high finished sheets has kept pace with the growth of the business. The earlier tonnages were turned out with inadequate equipment and insufficient space. New buildings and equipment have been added from time to time until at present there is ample space and facilities for the hand-

ling and finishing of large tonnages in any special finish desired.

Both tonnage and quality of high polished sheets have steadily gained during the years which have elapsed since Armco filled its first scattering orders for these special finish sheets. In the number of tons produced and the high finish which is now given these sheets the change reflects the growth of the automobile and stove industries from which the demand for this product has come. The technical difficulties which were overcome, the increase of tonnage at the same time that new methods of production were being installed, and the highly polished, densely surfaced sheets which are now being rolled, all mark one of the production triumphs of The American Rolling Mill Company.

View Showing a Roughing and Finishing Stand in the Sheet Mill.

Chapter IX

The Development of ARMCO Ingot Iron

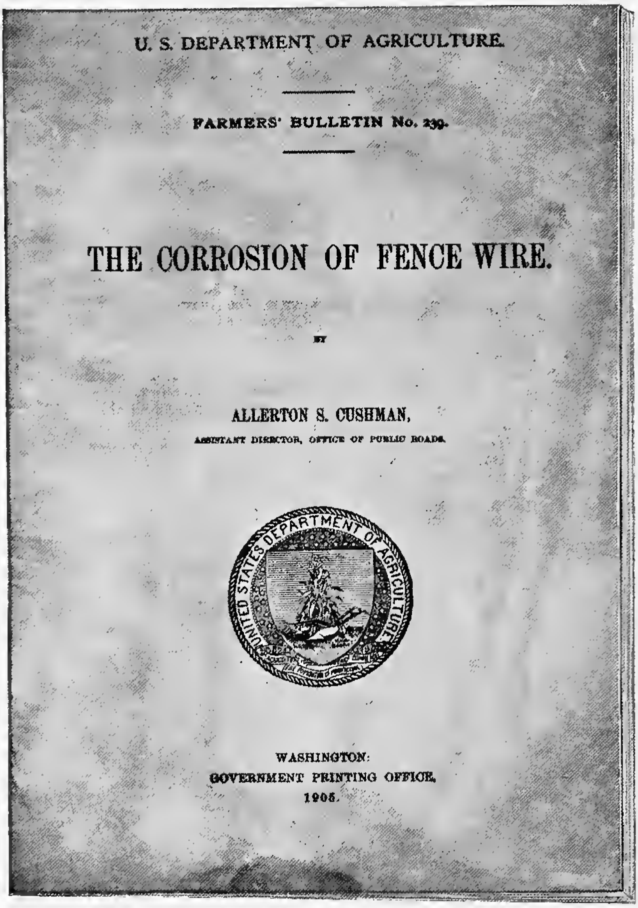
Early Operations—Cushman's Bulletin on "The Corrosion of Fence Wire"—Steel Practice Abandoned—Galvanized Waster Losses—Development of Acid Test—Consideration of Copper and Gases—Research Building—Open Hearth Troubles in 1908 and 1909—Effect of Pronounced "Critical" Range of Temperature on Rolling Processes—Ingot Iron Protected by Patents—Higher Manufacturing Cost of "Armco" Ingot Iron—Welding and Enameling Quality—Electrical Conductivity—East Side Works Started—Modern methods of Manufacture—Galvanizing Standards—Grand Prize Award—Uses of Ingot Iron—Conversion Arrangements—Licensing for Manufacture and Sale in Foreign Countries—Addenda.

STARTING with an idea gained from the study of old-fashioned, hand-made, pure iron and spurred by the suggestions contained in a Government bulletin, The American Rolling Mill Company has accomplished a task considered impossible by authorities on the metallurgy of iron and steel as late as 1905. The history of this accomplishment is made up of human perspiration, trials, discouragements, dangers and disappointments, all poured together into one great achievement—the manufacture of "Armco" Ingot Iron. The achievement is the production in commercial quantities in an open hearth furnace of a pure iron similar to the iron manufactured before the invention of the Bessemer and open hearth processes.

To start at the beginning, the development of "Armco" Ingot Iron was forecast by the pioneer spirit that in 1900 determined upon the construction of a basic open hearth plant for the production of steel to be rolled into sheets for galvanizing. Up to this time the galvanizing of basic open-hearth steel sheets had not been considered a success, the galvanizers demanding sheets manufactured by the acid open hearth or Bessemer process.

The American Rolling Mill Company was also a pioneer in gathering together under one management the various manufacturing operations in the production of steel sheets from the raw materials to the finished product. Prior to 1900 the manufacture of steel, the rolling of it into sheets, the galvanizing operations, and the forming of sheet metal building materials had been considered as separate industries.

It was an earnest little group of men who started operations in February 1901, the plant consisting of one twenty-five-ton basic open hearth furnace, a small hand-operated bar mill, four sheet mills, one galvanizing pot and a factory for the manufacture of roofing and other formed sheet metal products. Their pioneer undertaking immediately justified itself, for, from the beginning of



U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 239.

THE CORROSION OF FENCE WIRE.

BY

ALLERTON S. CUSHMAN,

ASSISTANT DIRECTOR, OFFICE OF PUBLIC ROADS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

Pamphlet that Led to the Manufacture of Ingot Iron

operations, the basic open hearth sheets were successfully rolled and galvanized.

During those first struggling years many experiments were made and all available literature consulted in an effort to better the quality of sheets produced. The first real ray of light came in 1905 in the shape of a pamphlet,

published by the United States Department of Agriculture as Bulletin No. 239, entitled "The Corrosion of Fence Wire," by Dr. A. S. Cushman. In this bulletin Doctor Cushman stated that a great many complaints had reached him, because the steel wire universally used by the farmers was rapidly rusting away, and an investigation was made with a view to alleviating their troubles. The result of his investigations brought out the following conclusions (page 18 of Bulletin No. 239):

> "That modern Bessemer and Basic Open Hearth Steel rusts much more rapidly than Iron Wire."
>
> "That Manganese, especially if it is unevenly distributed in the Steel, is at least in part the cause of the trouble."

Doctor Cushman also pointed out the greater destruction of steel by electrolysis as compared with iron and attributed it to the presence of manganese and various other metalloids found in steel in greater quantities than in iron.

The causes of corrosion were covered so thoroughly by Doctor Cushman, and the effects of metalloid impurities were pointed out so clearly in this pamphlet that The American Rolling Mill Company determined to make an effort to produce open hearth metal of the highest commercial purity which would be not only as free as possible from manganese but also free from the other four chief impurities of which no special notice had previously been taken in the manufacture of steel.

At first no effort was made to manufacture a material without ferro-manganese but it was reduced to as small an amount as possible and the product was simply a low manganese steel, the manganese ranging from .10% to .20% and the carbon analyzing about .04% in the finished annealed product. So far the practice had not deviated greatly from standard open hearth methods but exceptional care had been exercised in applying these methods so that the sheets produced had a nice appearance when galvanized, resisted corrosion better than common steel, and were well accepted by the trade.

In December 1906, at a convention of culvert manufacturers held in Crawfordsville, Indiana, corrosion tests were exhibited showing the advantages of the special analysis, low manganese and low carbon sheets then being made by The American Rolling Mill Company.

The eagerness with which these demonstrations were received encouraged further efforts to produce pure iron.

Experiments were made to reduce still further the carbon and manganese but it was found that when the manganese was reduced below .10% the resulting product was so "red-short" when rolled on the bar mill that the scrap loss was too excessive to permit economical production. The making of material with a manganese content lower than .10% was therefore discontinued for a time but was later revived and finally a sheet was produced which averaged not over .10% manganese. Further efforts to reduce this element below .10%, however, resulted in such great losses in rolling on the bar mill and sheet mills that the attempts were considered failures and the product remained at a standstill for a considerable length of time.

Experience having proved that the practice common to steel making would not produce a material of exceptional purity, it was finally decided to abandon entirely the methods employed in steel manufacture and strike out on new lines in an endeavor to produce pure iron containing only slight traces of impurities.

The use of high grade raw materials was first settled upon, and experimental heats were "run" in which the carbon and manganese had been eliminated to the greatest possible extent. To accomplish this it was necessary to do with deliberation what the experienced steel makers had been striving to avoid. For instance the bath of molten metal was highly oxidized in order to "burn out" the carbon and manganese, and aluminum was added as a deoxidizer. As the impurities burned out additional heat was required to keep the metal in a molten state. To reach a fluidity necessary for "tapping," the abnormally high temperature of 2900 to 3100 degrees Fahrenheit was required. This material, with care, was rolled successfully on the bar and sheet mills and galvanized satisfactorily. The manufacture of pure iron had passed from the experimental stage to a production basis and the first big step was taken.

At this time separate records were not kept of galvanized iron and galvanized steel wasters. As the iron manufactured was only a small percentage of the total galvanized sheets produced, it was not until the waster loss reached an alarming figure that these separate records were kept.

This promptly showed that the galvanized iron was running 40% to 60% wasters; that a large proportion of these were not even commercial wasters, but were so defective as to be fit only for scrap. The galvanizing process caused extremely large blisters, some a square foot or more in area. These blisters were on the base metal and seemed to be caused by expanding gases. Evidently the problem of deoxidization was not completely solved.

Then began a thorough study of how this material, after having been superoxidized in the furnace to "burn out" the impurities, could be so deoxidized that it would not only roll well on the mills but would galvanize with a low percentage of wasters.

In 1907 considerable experimental work was carried on to effect deoxidation and the records show that the furnaces were suffering from the high temperatures necessary to eliminate the impurities. The ladle linings deteriorated rapidly and stopper rods frequently burned off. This was a serious matter, for in these early days of the production of Pure Iron the burning out of a ladle lining was a calamity. With the limited amount of equipment then possessed, it was occasionally necessary to shut down the entire plant until repairs had been effected. But by the last of 1907 difficulties had been so far overcome that a comparatively pure iron which could be successfully galvanized was being produced in the open hearth furnace. This material was called Ingot Iron, the term indicating the fact that it was iron produced in the form of ingots.

A new discovery was then made. In dissolving Ingot Iron in the chemical laboratory for the purpose of analysis it was found that the material resisted the dissolving action of acid to a greater extent than steel. So great was this resistance that to expedite laboratory work, it was the practice to add to the samples to be dissolved a small amount of phosphorus which hastened the process. The result of this was to introduce the "acid test" to indicate the rust-resistance of Ingot Iron. Thousands of small blue prints, showing the action of acid on Ingot Iron and competitive materials, were sent to prospective customers. This test indicated very clearly the superior corrosion resistance of Ingot Iron over ordinary steel. Thus another interesting step in the development of this material was accomplished. These tests were later discontinued because of the ruling of The American Society for Testing

Materials that they only showed the effects of accelerated corrosion and were of no practical value.

In the open hearth records for June 13 and 14, 1908, is found the first indication of heats of exceptionally pure "Special Iron" (S.I.) being produced regularly, the carbon and manganese being down to .03% to .04%, the sulphur .028% and the phosphorus too low for determination. These heats were followed by heats of similar analysis, and the production of pure iron in commercial quantities was proved to be practical.

In December of this year (1908) at the convention of culvert manufacturers, held in Oklahoma City, the representative of a competitor, in attempting to account for the rust-resisting properties of Ingot Iron, declared that The American Rolling Mill Company had added copper to their product to get this rust-resistance. In support of this claim, a small sample of metallic copper was exhibited which, he stated, had been separated from Ingot Iron purchased in the open market. The American Rolling Mill Company reiterated its stand for purity as the reason for the rust-resistance of "Armco" Ingot Iron. Notwithstanding the position of The American Rolling Mill Company this new coppered-iron theory was eagerly seized upon, one competitive company eventually going so far as to produce a material designated by them as "Iron plus Copper and Manganese." Eventually the copper was dropped and this competitive product was manufactured, advertised, and sold as "Pure Iron" until litigation disclosed the fact that only The American Rolling Mill Company was privileged to manufacture this material by the open hearth process.

Although these statements about the addition of copper were not taken seriously by The American Rolling Mill Company, they were considered of sufficient importance to warrant further investigations. The only impurities that had been considered in the manufacture of iron or steel by metallurgists up to this time were the so-called "big five" elements: sulphur, phosphorus, carbon, manganese and silicon. The chemical analysis of Ingot Iron, taking only these impurities into account, warranted its being advertised and sold as 99.94% Pure Iron.

Investigations showed, that while the copper in ingot iron did not average higher than in normal steel, the fact that no attempt was made to control it permitted a wide

variation of this impurity; and as copper cannot be eliminated or even reduced in open hearth furnace practice it was necessary to keep it out of the furnace by charging only raw materials which were practically free from this element.

Having opened the door of research to the investigation of elements other than those originally known as the "big five," it was found that Ingot Iron, in addition to copper, contained certain gases. In order to properly represent Ingot Iron to the trade we published the total amount of impurities, including copper and the gases. We also published the guaranteed analysis of 99.84% pure iron, after deducting all sulphur, phosphorus, carbon, manganese, and silicon, as well as copper, and the gases, oxygen, hydrogen, and nitrogen.

The decision to consider gases as impurities in iron and steel necessitated the devising and developing of methods of determining these elements, this particular work not having been undertaken before.

The first steps along these lines were the building and proper equipping of a metallurgical research and chemical laboratory. This project was carried through, and the result in 1910 was a laboratory, second to none then existing in building, equipment, and personnel, devoted exclusively to metallurgical and analytical problems in the production of "Armco" Ingot Iron.

The completion and placing in service of the research laboratory marked the beginning of a new era in the history of Ingot Iron. This laboratory was not a control laboratory for the open hearth but was devoted to metallurgical and chemical research work for which it was completely equipped. In it many methods of analysis have been devised and developed which are giving more accurate results than methods previously in use. Perhaps the most notable of these is the "Gravimetric Determination of Iron" which was perfected in 1911. By this method results can be secured which are accurate to within two one hundredths of one per cent. Results secured by methods previously used were accurate only to one tenth of one per cent, this error being three hundred per cent in excess of any error of the new method.

Efforts to secure iron of extreme purity were centered in the open hearth department during the years 1908 and 1909. Every practical suggestion, including many that were apparently impractical, was tried. The principal

difficulties were the control of the high temperatures necessary in producing Ingot Iron and the proper deoxidizing of the metal. The following interesting entry is found in the record of No. 1 furnace operations.

> "About 10,000 lb. metal cut through chill into slag pocket. After opening slag pocket we found that furnace was beyond temporary repairs. Down for general repairs at 8.00 p.m. June 20, 1908."

The furnace-working of Ingot Iron has always been more costly than steel. A heat of steel can be prepared for tapping in from nine and a half to twelve hours and only requires a final temperature of approximately 2700 degrees Fahrenheit. To eliminate the impurities completely, as far as it is practically possible to eliminate them, Ingot Iron must be held in the furnace approximately two hours longer than steel. The excess time is at a temperature above the maximum required for steel, increasing to between 2900 and 3100 degrees Fahrenheit when ready to tap. An additional expense also lies in the fact that the yield of Ingot Iron is always considerably lower than the yield of steel heats. The high temperature oxidizes more of the original charge, the impurities are a desirable loss and the slag takes up from 3% to 4% more iron than the slag of steel. Of the materials charged into the furnace there will be, in the case of steel, an average yield of 94%, but in the case of Ingot Iron the final result will be only 91%.

The deoxidizing of Ingot Iron was perhaps the greatest of all problems. Many strange degasifying agencies were tried. Stirring the bath with green wood seemed to secure a favorable result as the following entries appear frequently in the records: "Green wood used to stir bath"—"Stirred with saplings and small trees." This treatment depended for its efficiency upon the ability of the men to keep the bath in motion. Sometimes the strenuous exercise of wielding a big sapling in the intense heat of the furnace caused them to call it "good" too soon; therefore the results secured were variable and could not be depended upon. However, the surrounding territory was completely denuded of young trees during the reign of this practice. The effect of a barrel thrown into the ladle apparently secured proper results, for the practice was continued for

some time. Frequently a box, in an emergency, was substituted for the barrel and later all available boxes and barrels seem to have been used up for the records show only that "wood was used in ladle."

Mill scale was also used in large quantities with frequently good results but was not to be depended upon to secure the same results under apparently the same conditions. Silicon was tried in the ladle with more or less success; also cold iron in the form of sheet bars was thrown into the molten metal to cause it to "work" or boil and give up some of the imprisoned gases.

Many degasifying agents were tried in an effort to properly purify Ingot Iron. Some were too expensive for use in large quantities, and others proved to be ineffective and some degasifiers brought results entirely unlooked for. One combination blew off a furnace roof and at another time all the metal was blown out of the ladle. Some of the efforts to deoxidize the iron caused the metal to foam when poured and produced porous, spongy ingots. Sometimes they were mere shells, the "gas pipe" being abnormally large and extending practically the entire length of the ingot. This lack of density enabled the workmen to make a great display of apparent strength by carrying with ease ingots which, judged by their size, should weigh from nine hundred to a thousand pounds.

Many of the efforts to eliminate gas caused "wild heats," which were poured all over the floor to avoid salamanders. With every precaution taken the metal would often freeze before the ladle could be emptied and over half a hundred of the dreaded salamanders had to be buried in the ground, a dead loss. Clothes were burned; many men received burns which left scars, but the work was carried on with a realization that no great undertaking is accomplished without hardships.

It had been discovered very early that aluminum was a most efficient deoxidizer but this element was expensive and frequently was alloyed with impurities which decreased its efficiency. Nevertheless it was the most practical substance to use in deoxidizing. At first it was used in combination with other elements in varying quantities. Later it was used alone in amounts from eighteen to two hundred pounds to the heat, but with this variation it was found that an overdose produced iron which was contaminated by the deoxidizing element whereas too small

an amount failed to accomplish the desired results. Considerable experimental work was necessary before the use of this element as a deoxidizer was under complete control.

Open hearth furnace troubles were by no means the only troubles experienced in the early manufacture of Ingot Iron. As the iron was produced with a gradually decreasing amount of contained impurities it was found to develop pronounced peculiarities in its working qualities on the bar and sheet mills. The pure iron had a well-defined "critical" range of temperature in which it could not be worked. The sheet mill furnaces were small and there was usually a difference in temperatures between the ends of the bars when heated for rolling into sheets. It was soon learned that the hot end of the bar worked all right until it had cooled to a certain temperature when it checked, cracked, and sometimes broke entirely in rolling processes. The end which was not so hot worked well and without signs of breaking. Common sense prompted the hot-mill men to equalize the temperature of the iron, and they attempted to secure the heat at which it rolled best. To do this the practice of cooling the hot ends by "boshing" was adopted and when the entire bar was cooled below the "critical range" it would roll without further trouble. This "critical" temperature range was only an indication that the material was very near a state of pure iron in which condition the "critical" zone of temperature is most pronounced though at that time very little was known of the phenomena of "critical temperature." The present sheet mill practice is to "water" by spraying the ends of bars heated to the critical temperature, but the modern sheet bar furnace is so built and controlled that it is seldom necessary to cool bars before rolling.

Loss from "clay piped" bars was a constant source of trouble on the sheet mills. Although this trouble was experienced with steel as well as with iron, it tended to complicate and aggravate the troubles of producing pure iron sheets. This trouble was a result of the method of "bottom pouring" ingots where the molten metal was "teemed" into the center of four groups of four ingots each, with clay lined conduits leading to each group of ingots. The clay was necessary to protect the conduits, but a part of it would frequently become entrained in the molten metal as it was being poured, and, in the rolling processes, would cause laminated sheets. The men, at

that time, were not familiar with this defect and would discover it only after the bars had been partly rolled into sheets. When this defect was definitely located, the bars were carefully sorted and the piped ones thrown out; although this considerably cut down the out-put of the mills. It was not unusual to lose sixty to seventy pairs a turn because of "piped bars." As the men were paid on a tonnage basis and a great many of the bars were partly finished before the "pipe" was discovered the financial loss to the mill crews was considerable.

As long as the production of Ingot Iron in sheets was restricted to the heavy gages required by the culvert industry, it was possible to roll on the bar mill the comparatively heavy bars required without much trouble from checking and breaking of the material in the "red-short" range of temperature. This was done by finishing at a high heat. Later when lighter gage sheets were required, it was necessary to roll lighter bars, which meant speeding up men and machinery to finish them before they cooled to the "critical" temperature. When bars lighter than nine-sixteenths of an inch were rolled, trouble started all the way down the line. The ingots were heated so hot that molten metal dripped from them. Whenever one ingot touched another they would stick and actually become welded together. This would frequently happen with three or four, or more ingots which sometimes could not be separated until the furnace cooled, when the front was partly demolished so that the ingots could be removed and cut apart. It was found by experience that Ingot Iron could stand a much higher temperature than steel. A heat that would burn steel would give to Ingot Iron good working qualities. When the ingot started through the bar mill, it was a fight to finish the rolling before the ingot cooled to the "critical" temperature. There was room only to keep the hot bars moving and it was not possible to hold them while they cooled through the "critical range" without slowing up production. A great many bars were lost by "breaking" on the last pass through the bar mill.

Because of the peculiar characteristics of Ingot Iron, the sheet mill had a large waster loss from light gage "stickers." In producing thin sheets it is necessary to roll them in packs of four, six, or eight. The soft iron would stick as though welded, and ordinary efforts to separate

the sheets resulted only in tearing them. This peculiarity of pure iron almost caused the abandonment of all efforts to produce Ingot Iron sheets in light gages, but experiments were made by throwing coal dust, or saw dust between the hot sheets while they were being rolled. Eventually a method was discovered which prevented the sheets from sticking so tight as to prevent opening and the production of light gage Ingot Iron sheets proceeded under difficulties.

Later on a further discovery was made which greatly facilitated the production of light gage Ingot Iron sheets. Because of the disablement of one of the mills a "pack" of iron became almost cold before it could be given the final pass through the rolls; but the "cold pass" caused it to open with much less trouble than had been previously experienced and "cold passing" of all light gage Ingot Iron on the sheet mills became the practice.

By July 1909 Ingot Iron was being produced on a scale which clearly demonstrated that it was entirely practical to manufacture in commercial quantities iron of a purity that had never been produced before in other than small quantities and with laboratory equipment. The qualities of this material were so unusual that it was desirable to protect it and its manufacturer by patents. An application for a patent in the United States was filed July 16, 1909. This was granted and issued November 23, 1909, and was promptly followed by the securing of patents in practically all civilized countries. In Great Britain the right to manufacture Ingot Iron was given to an English company who, after being carefully instructed as to methods, has successfully produced it in large quantities. It has become a necessity to the manufacturer of high-grade special steels of that country.

A summary of the difficulties encountered in the manufacture of "Armco" Ingot Iron shows the material must, of necessity, cost more than steel, even though methods of production are refined and brought to a high degree of perfection.

It is necessary to start with raw materials which are extremely low in copper and it is desirable that other impurities be lower than the average because the copper cannot be removed, or even reduced, in manufacturing processes; furthermore unless the raw materials are low in the other elements additional time and heat in the furnace will be required to bring the iron to the necessary high state of purity.

In the production of Ingot Iron under the most favorable conditions it is necessary that each heat remain in the open hearth furnace approximately two hours longer than would be required in the production of steel. This means 20% greater cost for labor and fuel, decreased production and increased furnace deterioration.

As iron approaches a high state of purity its fusing, or melting temperature is raised. Ingot Iron, being an exceptionally pure iron, requires a temperature about 200 degrees (Fahrenheit) higher than is necessary in steel production. This high temperature decreases by 20% to 35% the life of the furnaces as compared with a furnace on all steel production. More fuel is also required to generate this tremendous heat.

The coal used in making producer gas for the manufacture of Ingot Iron must be carefully watched for sulphur content as coal high in this element would cause an expenditure of additional time and effort in securing the practical elimination of sulphur in the iron.

In eliminating or reducing the impurities to a minimum it is necessary to highly oxidize Ingot Iron. Later, to deoxidize it requires materials and methods more expensive than is usual in steel practice.

Because of the pronounced critical range of temperature peculiar to Armco Ingot Iron it is necessary to handle it with extreme care in all rolling processes. This slows up production, and with a maximum of care used, the waster loss from iron breaking in the critical temperature is considerable.

The many peculiarities encountered in the working of Ingot Iron make it necessary that men be specially trained to handle this material. As a rule, regardless of previous training, it is necessary that a man work with Ingot Iron for several months before he is familiar enough with the material to be of value in his department. The training of men is expensive, but by this method only can the high quality of Ingot Iron be secured and maintained.

Because of the purity of Ingot Iron and the methods used in its manufacture this material is more homogeneous than steel and therefore flows more uniformly when heated to a melting temperature. This characteristic led to its use in welding for many purposes where the cost or efficiency of the welded articles depended upon the quality of the weld or the ease of welding operations. The welding

quality of Ingot Iron created such a great demand for this material in the form of welding wire and rods that conversion arrangements were made, which resulted in the manufacture of large quantities of "Armco" Ingot Iron welding rods and wire to take the place of the welding materials of foreign and domestic manufacture previously used in this country.

The arrangements by which Ingot Iron welding materials were produced also permitted the manufacture of Ingot Iron wire. The high conductivity of this commercially pure iron wire led to its use for electrical transmission purposes in many places where copper wire had previously been used. It had long been known that pure iron was a better conductor of electrical current than normal steel. Tests were made which showed that the electrical conductivity of Ingot Iron was approximately 50% greater than the conductivity of steel. Compared with copper as a standard, Ingot Iron has a conductivity of 18 per cent.

The fact remains however that the manufacture of commercially pure iron was conceived and developed in order to secure a ferrous metal more resistant to corrosion than steel. In the beginning no effort was made to attribute to Ingot Iron any virtues other than the qualities of "rust-resisting" and "electrical conductivity" common to pure iron; however in the deoxidizing and degasifying of Ingot Iron to secure a sheet which would galvanize in a superior manner a material was produced that would stand high temperature without blistering. At this time the art of vitreous enameling was being developed and the enamelers were experiencing troubles directly traceable to the sheet metal used as a base. In burning the enamel the volatile gases imprisoned in the steel sheets often broke through the coating and caused defects which appeared as blisters or other defects, some no larger than a pin point. These defects were not only unsightly but made the coating more or less porous and unfit for use as a protection against the action of acids or other agents destructive to the base metal. Ingot Iron, being practically pure iron and almost entirely devoid of gases, quickly gained favor as an enameling base. As a check on the quality of Ingot Iron, sheets which were to be used for vitreous enameling were subjected to a blister test. This was a practical testing of several sheets from each heat. The sheets were heated to a temperature considerably above that at which

the enamel was burnt and carefully examined for blisters. The smallest amount of gas, if present in the metal, would expand under the heat and form blisters on the surface of the sheets. This would cause the material represented by the samples to be rejected for enameling purposes.

The successful manufacture of Ingot Iron sheets and their demand by the trade were largely responsible for a decision of the management to enlarge the plant. Accordingly in September 1911 the East Side Works of The American Rolling Mill was placed in operation. This new plant with its modern manufacturing facilities permitted a closer application of the quality methods of production devised in the old plant during the development of Ingot Iron.

The new plant was designed to operate on a "large ingot practice" and top-poured ingots ranging in weight from four thousand to seventy-five hundred pounds were produced. Top-pouring the ingots reduced to a minimum the loss from clay piped bars. The large ingots permitted better blooming and bar mill practice because the larger mass of metal could be more thoroughly worked than was possible in rolling small ingots.

The new equipment was designed for standard steel plant practice. However ample space was provided to permit the blooms to cool through the red-short zone of temperature without slowing up production. Eventually, new equipment was added to the standard bar mill which automatically takes care of Armco Ingot Iron blooms while they are cooling from the high to the low temperature at which it is safe to roll commercially pure iron. This reduced to a minimum the troubles incident to rolling the material at critical temperatures, but it was not without some trouble and considerable loss of material that the workmen were trained to recognize the critical range of heat in Ingot Iron and to avoid it in rolling sheet bars.

In the sheet mill department of the new plant the furnaces were built of ample size to secure an even heat on the bars. The roll trains are electrically driven and every modern means provided to produce high grade sheets.

It was known that the best results in annealing Ingot Iron could be secured only when the annealing temperatures were definitely known and controlled. Therefore, the annealing furnaces of the new plant were equipped with

electrical pyrometers for heat control. This insured Ingot Iron sheets of a softness, ductility, and evenness that could be secured by no other method of annealing.

The quality of Ingot Iron, the rolling of it into sheets, and the annealing had been very well standardized before attention was turned to the galvanizing department. Though the new plant included modern galvanizing equipment, the zinc coating of galvanized Ingot Iron sheets was far from being uniform in weight or quality. In common with all galvanizing plants at that time there were no standards of inspection. As a first effort toward better galvanizing practice there was established a system of weight inspection to determine the quantity of the coating. Within a few months sufficient data were secured to definitely establish standard weights of coating for the different gages and grades of sheets produced.

A distinction was made in the coating standard between Ingot Iron and steel, it having been discovered that the quality of coating taken on by Ingot Iron was superior to the coating on steel because there was less iron alloyed with the zinc. Pure iron dissolves in molten spelter only one-fourth to one-fifth as rapidly as steel. Because of this characteristic of Ingot Iron, gears and other parts of galvanizing machines which are subjected to the action of molten spelter and flux are being made of "Armco" Ingot Iron.

After coating weights were standardized, work was started toward the establishing of standards of surface inspection of galvanized sheets. The result was that orders were issued to consider as "wasters" galvanized sheets which contained certain blemishes. That there might be no error each inspector was provided with a set of samples showing the various conditions to be considered as "defects." This resulted in a higher standard of inspection of galvanized Ingot Iron sheets and reduced to a minimum any possible error of judgment on the part of inspectors.

At the Panama-Pacific International Exposition held in San Francisco in 1915 "Armco" Ingot Iron was placed in competition with all other materials on a strictly merit basis, the coveted Grand Prize being the reward of merit. Competitors made every effort to prevent the recognition of "Armco" Ingot Iron by the Jury of Awards. They attempted to show that this material was neither new nor

unique and that the process of manufacture was only a steel making process pushed to an extreme that produced burnt steel. Attention of the jury was drawn to the fact that "Armco" Ingot Iron was made in an ordinary open hearth furnace designed to produce steel; that the initial charge was the same as for steel; and that the materials were melted, tapped from the furnace and poured into ingot molds in the same manner as steel; therefore it must be steel.

The jurors for the mines and metallurgy group of displays carefully considered the questions raised by the opponents of "Armco" Ingot Iron. They could not, however, ignore the fact that the material was different from steel; that it more closely approached the element iron in analysis than did steel; and that for many commercial purposes Ingot Iron could be used to a better advantage than steel.

The jury was composed of men of international importance in the metallurgical world. This highest tribunal gave to "Armco" Ingot Iron the highest award within their power to bestow.

THE AMERICAN ROLLING MILL CO.
Middletown, Ohio

GRAND PRIZE
FOR
ARMCO INGOT IRON

A recent development in open hearth furnace practice resulting in the manufacture of a special product known commercially as ARMCO INGOT IRON and having the following special characteristics:

CHEMICAL PURITY, RUST RESISTING PROPERTY, WELDING QUALITY, ENAMELING PROIERTY. ELECTRICAL CONDUCTIVITY.

Panama-Pacific International Exposition.
San Francisco, 1915

This was the only Grand Prize awarded for rust-resisting properties, chemical purity, welding quality, enameling, property, and electrical conductivity. The awarding of this Grand Prize proved the claims made for the commercially pure iron developed in a basic open hearth furnace.

To thoroughly catalogue the uses of "Armco" Ingot Iron would be to tabulate every use of metal where the installations are subjected to corrosive influences from shingle nails to locomotive jackets, and from underground tanks to metal lath. In addition it would be necessary to list the uses of metal where softness, uniformity and ductility of the metal are desired qualities as in the manufacture of stoves, ranges and household enameled products.

It is a matter of history, however, that the demand made by manufacturers of corrugated metal culverts for a material more durable than steel, was one of the original factors which led to the development of Ingot Iron. Therefore it is not surprising that the largest single demand for "Armco" Ingot Iron tonnage is from the manufacturers of "Armco" Culverts made of corrugated galvanized Ingot Iron.

Engineers in searching for the best and most economical culvert, have decided that a corrugated metal culvert of No. 10 to No. 16 gage combines all the good points of tile, wood, concrete, and brick, and at the same time eliminates all the weak points of these various types. Practically 75% of all corrugated metal culverts built today are made of rust-resisting Ingot Iron and are giving the best of service.

"Armco" Ingot Iron also made rapid strides in the flume industry. It is now used on many new installations and for the replacement of old, rotted wooden flumes which have gone to pieces after giving relatively short service. Wood is leaky and is bound to rot, causing trouble in a comparatively short time. Ingot Iron flumes, owing to their rust-resisting qualities, give a splendid service under the severe conditions arising from carrying all kinds of water. They are leak-proof and the upkeep cost is small.

For roofing, siding and all building metal-work exposed to the corrosive influence of the elements Ingot Iron has no superior; it has been used for all sorts of house, factory, mill, pier, and wharf construction. Ingot Iron is largely used for eave-trough, conductor pipe, cornice work, and window frames.

In the tank field "Armco" Ingot Iron has demonstrated its quality in installations ranging from small hot water tanks for the home to a gas holder of five million cubic feet capacity.

A very steadily increasing demand is made yearly on Ingot Iron for railway car construction of every descrip-

tion. Resistance to rust is an ever present requirement in the operation of all types of cars and the softness and ductility of the metal prevent early crystallization and consequent breaking due to constant vibration. These qualities make Ingot Iron equally valuable for mine and industrial cars of all kinds.

The unusual properties possessed by "Armco" Ingot Iron are responsible for the popularity of this material with the manufacturers of vitreous enameled products. It is used for enameled table tops, kitchen cabinets with enameled parts, stoves, range boilers, refrigerators and signs. A complete list of enameled articles made of "Armco" Ingot Iron would be a catalogue of practically all the vitreous enameled ware produced in the United States, for a survey of the field indicates that a very large percentage of the enameling stock used today is "Armco" Ingot Iron.

Stove builders were among the first manufacturers to take advantage of the versatility and adaptability of Ingot Iron. Polished sheets with a highly polished, dark blue surface came into demand for the exterior finish of the stove body, warming oven and other visible parts. Later the development of vitreous enameling opened a large market for enameled Ingot Iron stove parts including doors, drip-pans, splasher backs, etc. Several manufacturers are regularly producing all-enameled Ingot Iron ranges. On the books of The American Rolling Mill Company are to be found the names of hundreds of stove manufacturers who are buyers of "Armco" Ingot Iron.

Resistance to the corrosive influences of the soil, welding quality, and ductility are all important features in the manufacture of grave vaults. Since Ingot Iron possesses these qualities to a high degree, it is being used in large quantities by many vault manufacturers.

An increasing demand for metallic caskets has opened an almost unlimited field for Ingot Iron sheets. Furnished in several different surface finishes they make dependable caskets either for covering with cloth or with a natural wood grain or metal finish.

The growth of the power washing-machine industry has caused a heavy demand for galvanized Ingot Iron sheets for the construction of the tubs and other parts of washing machines. To resist the corrosive action of the strong soaps and soap powders used in washing clothes, it

is necessary that the material used be of a quality better than steel.

"Armco" Ingot Iron on the farm will be found in a diversity of equipment from culverts for the roads to ventilators for the barns. Here again its rust-resistance makes it valuable for the construction of silos, water tanks, well casings, stock waterers, corn cribs and grain bins, sewage disposal systems, refuse cans, flumes, milking machines, washers and wash tubs, dipping and scalding vats, stoves, furnaces, buildings constructed of metal, and Ingot Iron fencing. Many manufacturers of farm equipment now use Ingot Iron exclusively. They have found that it insures increased durability and longer service for their products.

In the welding field "Armco" Ingot Iron enjoys a most enviable reputation. Welders formerly used Swedish and Norwegian irons until the activities of the World War prevented the importing of these materials and made necessary the use of the best domestic welding iron procurable. The first essential of a good welding material is purity; that is, foreign elements such as sulphur, phosphorus, manganese, silicon, slag, and oxide must be at a minimum. The proper welding material must flow evenly and produce welds that are free of blow-holes, soft, hard, or brittle spots and it must be dependable in giving constant, good results. "Armco" Ingot Iron has been proved to be the equal of the best imported welding materials.

"Armco" Ingot Iron boiler tubes, pipe and casing are being demanded in increasing quantities, the fields into which they enter requiring material highly resistant to corrosion. In the steamboat inspection service of the United States Government, "Armco" Ingot Iron lapwelded tubes are accepted as meeting all the physical requirements of charcoal iron tubes in steam power driven boats or vessels.

In no other field is the versatility of Ingot Iron more pronounced than in that of wire products. Its peculiar characteristics of rust-resistance, electrical conductivity, and magnetic property adapt it equally well for farm fencing, electrical transmission lines, telephone and telegraph wire, bond and signal wire and myriad similar uses.

The wide range of uses of "Armco" Ingot Iron in sizes and semi-finished conditions beyond the ability of The American Rolling Mill Company to produce, has led to

special conversion arrangements whereby manufacturing specialists convert Ingot Iron billets or slabs, furnished by The American Rolling Mill Company, into tubes, pipe, fence wire, welding wire and rods, cold-rolled strips, heavy plates, rivets, nuts and bolts, nails, merchant shapes, skelp, etc. "Armco" Ingot Iron fence wire, welding wire and rods are being produced by the Page Steel and Wire Company with plants at Monessen, Pennsylvania, and Adrian, Mich. This company, at the present time, is converting approximately five thousand tons of Ingot Iron billets each year into wire and rod products. Through the close working arrangement between the Page Steel and Wire Company and The American Rolling Mill Company the wire and rod tonnage is being greatly increased from year to year.

Boiler tubes, pipe, and casing of Ingot Iron are made and sold by the Monongahela Tube Company of Pittsburgh. A good business has been developed for these products especially in the oil fields where corrosive conditions are severe.

"Armco" Ingot Iron rivets in large quantities are required for the manufacture of Armco Culverts and other products fabricated of Ingot Iron where the use of steel rivets would promote electrolytic corrosion. At present the Fowler Rivet Company, of Braddock, Pennsylvania, is manufacturing "Armco" Ingot Iron rivets by the cold heading process for cold driving.

When Ingot Iron strips, bars, structural shapes, nails, or plates beyond the limits of The American Rolling Mill Company are required, arrangements are made with mills producing these specialties to manufacture them from bars, billets, or slabs provided by The American Rolling Mill Company.

New uses for "Armco" Ingot Iron are constantly being developed. A recent demand for corrosion resisting chain made from Ingot Iron is now receiving attention. It is probable that in the near future arrangements will be completed for the manufacture of Ingot Iron chain under conditions similar to the arrangements for the production of wire and rods.

Ingot Iron has received much favorable attention from British engineers and scientists; it is used extensively on the railways. Some of our British licensees produce Ingot Iron in forms such as heavy sections and angles into which Ingot Iron is not manufactured in the United States.

AVERAGE YEARLY ANALYSIS OF ARMCO INGOT IRON.

1914	99.876% Iron
1915	99.879% Iron
1916	99.882% Iron
1917	99.872% Iron
1918	99.862% Iron
1919	99.867% Iron

COMPARISON OF ARMCO INGOT IRON AND STEEL HEATS—HEATS WERE MADE ON FURNACES 5, 6, 7, AND 8.

Period of One Month

Grade	*Average Tons Per Heat*	*Average Percentage of Yield*	*Average Time in Furnace*
ARMCO Ingot Iron	67.1	84.78	13.09 hours
ARMCO Steel	71.7	94.00	11. 4 hours

COUNTRIES IN WHICH ARMCO INGOT IRON IS PATENTED.

ARGENTINA
*AUSTRIA
BELGIUM
CANADA
CUBA
FRANCE
GREAT BRITAIN
*HUNGARY
ITALY
MEXICO
NORWAY
SWEDEN
UNITED STATES OF AMERICA

*Patents discontinued.

Chapter X

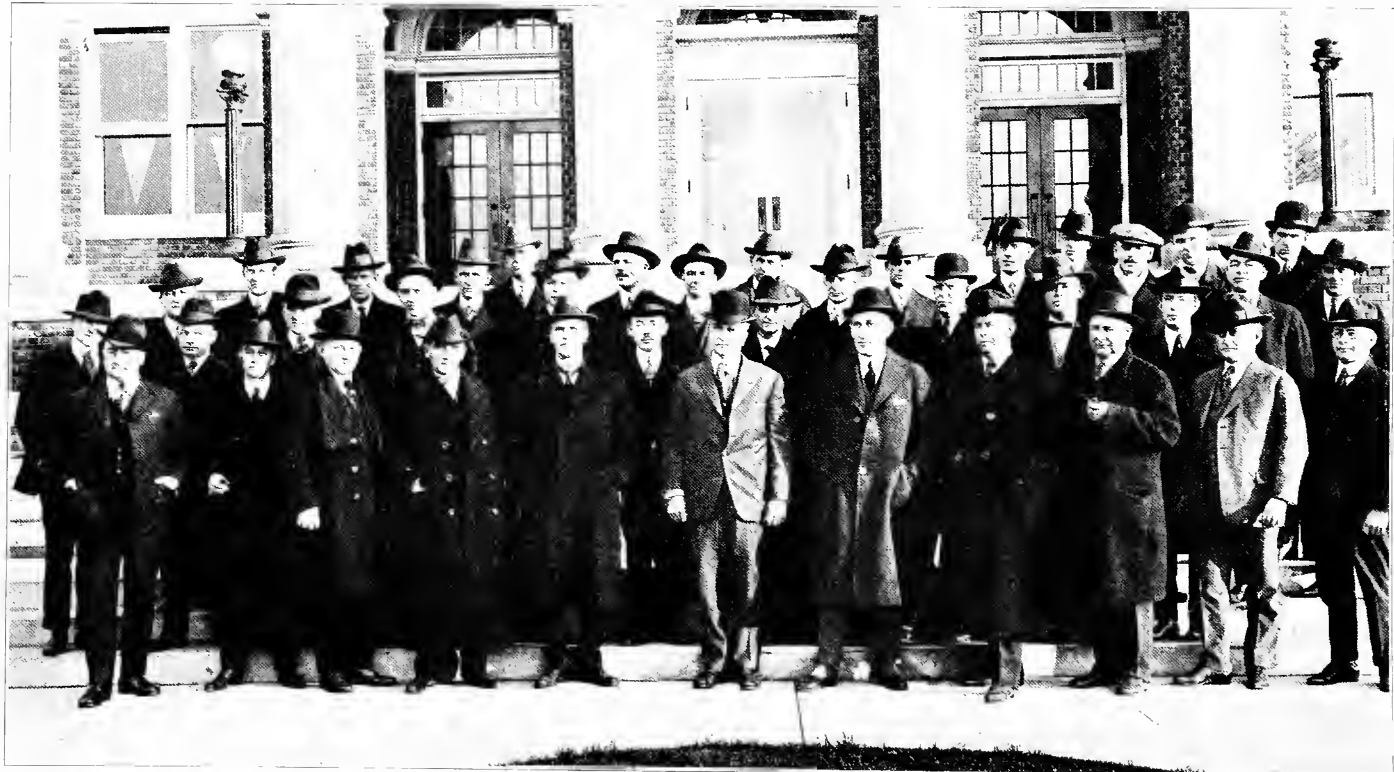
History of the ARMCO Culvert and Flume Association

The Watson Patent—The First Meeting of the Culvert Men and Armco—Subsequent Connection and Progress—Standardization of Product and Specifications—Plans and Development—Development of Other Products—The Flume Industry.

WHILE rapidly rusting fence wire was the thing that set the metallurgists at Washington on the scent of pure iron as the secret of rust resistance, it was the corrugated culvert business that first promised sufficient sheet tonnage to encourage The American Rolling Mill Company to follow up its experiments in the manufacture of pure iron in an open hearth furnace. Therefore, whatever Armco Ingot Iron stands for today with its diversified use in the manufacturing world, the culvert industry may justly lay claim to being the first in the field in its use of Armco Ingot Iron.

The history of the culvert industry is so closely identified with that of Armco that it becomes a very important chapter in The American Rolling Mill Company's own progress and development.

The Watson patent was the foundation for the corrugated culvert industry. James H. Watson, an inventor and manufacturer of sheet metal products, after some experimenting, developed the present corrugated culvert on which a patent was granted in May, 1896. In connection with Stanley Simpson, he endeavored by various means to develop this business, but was not able to make any substantial progress outside of his local community. In the early days a great many objections were made to this type of construction and a great many prejudices were formed against it, most road officials believing that it was too light and flimsy for the purpose for which it was designed. Mr. Watson was a man who had achieved considerable business success, but he was unable during his life to overcome these prejudices sufficiently to enable him to make the culvert branch of his business profitable.



Members of the Armco Culvert and Flume Manufacturers' Association 1918

From the time of his death, in 1900, to 1903, very little was done with the culvert business, but in November 1903, W. Q. O'Neall of Crawfordsville, Ind., purchased from the estate of James H. Watson his entire culvert business and patent. Mr. O'Neall then formed a partnership with Mr. Simpson who had been identified with the culvert business from its inception, and under the firm name of O'Neall & Simpson began a work which has resulted in the present development of the industry.

In 1904 O'Neall took over Simpson's interest in the business and during the same year sold patent rights and established factories in the states of Illinois, Indiana, Michigan and Ohio. These early manufacturers met with the same objections and difficulties which James H. Watson had encountered and there were many times when the entire project trembled on the brink of failure.

Partly by accident, the culvert manufacturers from the four states met in a little hotel at Defiance, Ohio, in 1904. They were in the midst of a very gloomy discussion of their troubles when a representative of The American Rolling Mill Company appeared on the scene. He was able by his enthusiasm to cheer up the meeting and to give many helpful suggestions that pointed the way to larger opportunities and altogether endeared The American Rolling Mill Company to the hearts of these hardy pioneers in the culvert industry.

In 1905 additional factories were started and in the winter of this year the first regular culvert convention was held at Crawfordsville, Ind. In the meantime, some of the culvert manufacturers had been in touch with other sheet manufacturers. Mr. O'Neall especially was impressed with the necessity of securing special material that would have the proper qualifications both as to workability and durability for culvert purposes.

By the time the culvert convention met again in December, 1906, at Crawfordsville, most of the territory under the patent had been sold and factories had been started or were being started in practically all of the territory of the United States. At this meeting at Crawfordsville, a relative corrosion test was made by Armco's Chief Metallurgist, R. B. Carnahan, Jr., showing the advantages of the special analysis culvert sheets then being made by the American Rolling Mill Co., over the ordinary steel that was being offered by its competitors for culvert purposes.

The result of this Crawfordsville meeting showed the possibilities in this industry and the need of a special analysis material that would resist corrosion to better advantage than the material which was then available for culvert manufacture.

At this time the acid test was being used as a means of showing the superiority of iron over steel. Thousands of little blue prints were made by the Armco chemists, and sent out to all prospective culvert customers.

There were no important developments during the year of 1907 except that every effort was being made toward the further development of pure Ingot Iron. This was the first year for which definite records of the tonnage of Ingot Iron consumed by the culvert companies were kept. The total amount was four thousand six hundred tons. The next convention was held in Chicago at the Great Northern Hotel about December 1, 1907.

In August of 1908 there was a meeting called at Des Moines, Iowa, to counsel with Mr. Lane, patent attorney, on the subject of the Watson patent. There were no representatives of any of the sheet manufacturers present, nor was it a full convention of all the members.

The next meeting was held in December, 1908, in the Klondike Hotel, Oklahoma City. The American Rolling Mill Co. and its two principal competitors were represented. The American Rolling Mill Co. was pressing its claim as to the purity of Armco Ingot Iron and acid tests were being conducted to show its superiority.

The chief metallurgist of one competitor read a paper in which he attempted to account for the rust-resisting properties of Armco Ingot Iron by the presence of copper. In proof of this claim he exhibited a small sample of metallic copper, which he said had been separated from Armco Ingot Iron.

The representative of another competitor read a paper on "Bloom" Iron. Notwithstanding the activities of competitors at this time, the culvert manufacturers believed in the ability of The American Rolling Mill Company to serve them best and the culvert tonnage at that period was almost doubled, the total being seven thousand tons.

It was during the early part of this year that the product which The American Rolling Mill Company was furnishing these companies was first advertised as "Armco" Ingot Iron and advertisements appeared in

the *Good Roads Magazine*, the *Manufacturers Record*, the *Metal Worker* and the *Iron Age*.

About this time the manufacturers who were operating under the Watson patent decided to form an association known as the National Corrugated Culvert Mfg. Co. This association was capitalized at $100,000, the only requirement for membership being that they manufacture, own and operate under the Watson patent. The object of the association was to collect and dispense information for the benefit of all of the several members and to coordinate their efforts in every possible way.

The next annual meeting of the association was held at the Stratford Hotel in Chicago in December 1909. The possibilities of the business seemed to be so great, that Armco's competitors made every possible effort to interest the organization in their products. There were sheet manufacturers other than Armco present at this meeting but they were not admitted into the session. By this time The American Rolling Mill Company was cooperating very closely with the members of the association and was supplying them with the greater part of the material which they were using. The association was beginning to form itself into a well organized body.

In the year 1910, as well as in all subsequent years, the annual convention was held in Chicago. The tonnage between the years 1908 and 1910 had again doubled, and due to its close cooperation with these companies Armco is supplying practically all of their requirements for culvert purposes.

During the ensuing years a gradual change took place in the organization of the culvert association. Many of the lesser substantial men who had originally owned the Watson patent were replaced by more aggressive and capable manufacturers and through this improvement in the association the tonnage continued to grow.

The development of the association has been even much more marked than the increase in its tonnage requirements. Today the cooperative work which the association is doing is one of the most valuable assets of The American Rolling Mill Company.

In 1916 the name of the national association was changed to the Armco Iron Culvert and Flume Manufacturers' Association and later changed to the Armco Culvert & Flume Manufacturers' Association. The prin-

cipal function of the association is to further the sales of Armco Ingot Iron culverts. This is accomplished by co-operative advertising, by the education of salesmen, by the standardization of products and the exchange of ideas in regard to development of equipment and new products.

In the first place the manufacturers cooperate in advertising for their mutual benefit. The growth of this advertising has been very rapid.

Under this plan, in the year of 1919, more than a million and a half pieces of literature were sent out in a direct advertising campaign for the purpose of promoting the sale of Armco Ingot Iron culverts.

In addition to the direct advertising, the association advertises in trade journals, exhibits products in connection with some of the national conventions, and in general does Armco educational work. The Armco trademark and triangle appear on the letterhead of all members of the association.

The combined sales force of this association is now between one hundred and one hundred and twenty-five. These salesmen are all given a special education in the making of Armco Ingot Iron and are continually spreading Armco information. In 1919 The American Rolling Mill Company instituted a course for the training of the salesmen at Middletown. Forty-one men were booked by the culvert companies for this special salesmen's course immediately upon its opening. The association also prepared at its own expense, a special sales manual to further educate their salesmen.

Perhaps the greatest work of the association has been to put the culvert business on a substantial basis. Any new developments made by one company are immediately communicated to all companies, and if worthy are adopted nationally. The association has always been a tremendous force toward upright dealings in culverts and has always stood for quality first. It is a great organized force for the maintenance of high standards in the corrugated culvert business.

The association, through its cooperation, has enabled the weaker members to take advantage of the developments which have been worked out by stronger companies and, as a result, all the companies have benefited. All the plants are equipped with the most modern machinery. This development has not been confined to culverts but has

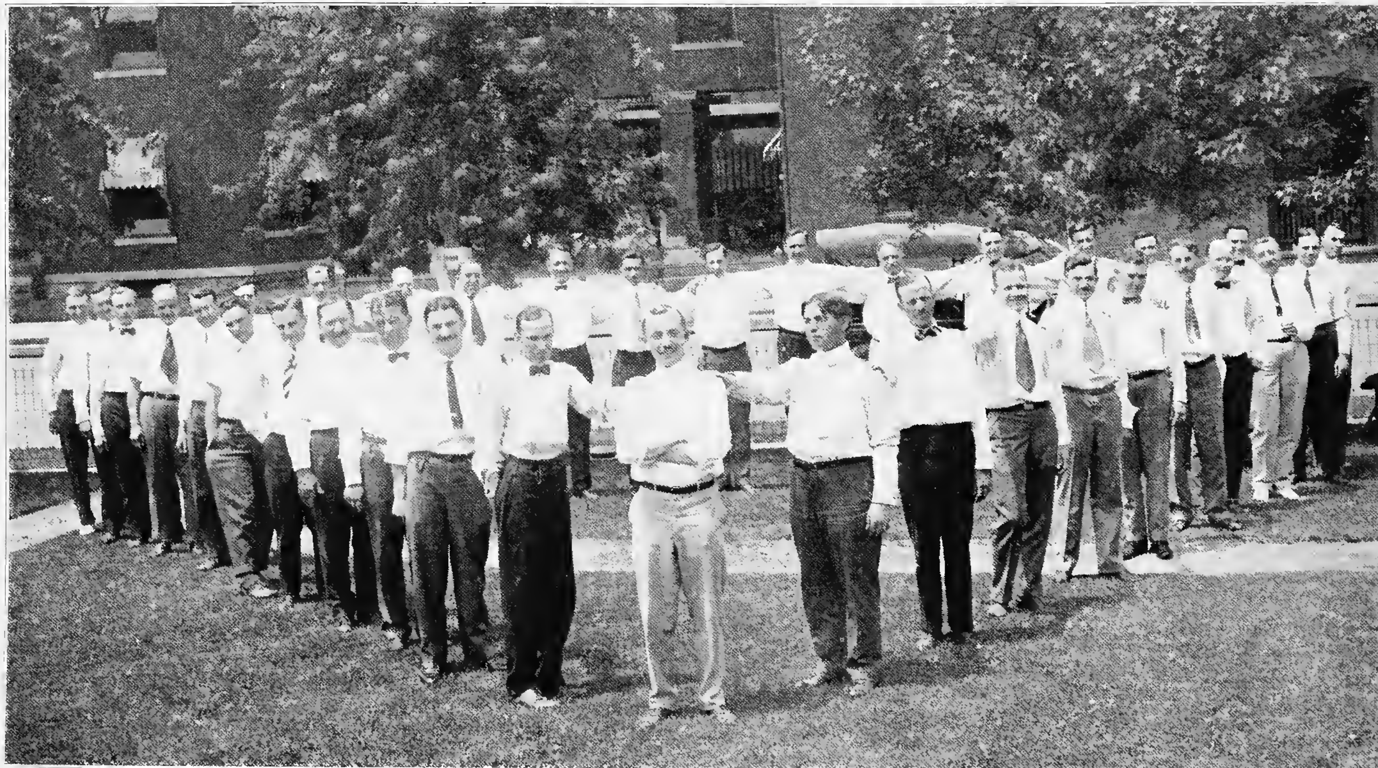
aided in the production of other products in which the companies are mutually interested.

Some of the western companies in the association are interested in flume building and have their own flume improvement association, which is handled in substantially the same manner as is the culvert association. They own and control practically all the basic patents which have been issued on flumes. While the flume business has not been as large as the culvert business, yet these manufacturers believe that the future in this line of work is very large. The development of other products such as metal signs, grain bins, watering troughs, hog troughs, storage tanks, and many other farm products has followed in natural sequence. The knowledge that any one company has amassed as to either manufacture or distribution of new products, is always available for any of the other member companies.

There are at the present time thirty companies comprising the Armco Culvert and Flume Manufacturers' Association. The total capitalization of these companies is $1,655,000.00 with a corps of one hundred and five salesmen.

The work of the association is always of the very highest standard and its very close cooperation with The American Rolling Mill Company has worked out to the advantage of all the companies concerned.

The Armco Culvert & Flume Manufacturers' Association has not only stabilized and built up the metallic culvert business of the country, but it represents one of the strong forces which guarantee the steady progress and development of The American Rolling Mill Company.



Armco Sales Force, 1914

Chapter XI

Selling ARMCO Products

Early Developments—Reorganization—The Sales Division—Material Sections—ARMCO Developments Section—Order and Schedule Section—District Office Organization.

THERE is no better picture of the remarkable growth of Armco than in the evolution and development in organization of its sales division. From a most modest beginning, in which but one or two men formed the contact with customers, it has gradually unfolded into a thoroughly efficient, well-balanced organization of more than one hundred individuals, together with an auxiliary group of export agents and representatives who reach out literally to every corner of the earth.

At the outset, the company's management wisely chose the field of specialty steel and iron products for its endeavors. This made necessary a highly specialized form of salesmanship and was the governing factor in the working out of problems of personnel and organization. The successful introduction and sale of the many highly specialized Armco products require a thoroughly intimate knowledge of each one of these products coupled with a selling ability of the highest order. This explains the fact that Armco has found it necessary to develop and train its own sales representatives. While in the early days the company was represented in several districts by commission agents, this method did not prove satisfactory. With but a single exception, Armco domestic representation today is exclusively handled through salaried employees.

It was no easy task to introduce and develop a market for a new product such as Ingot Iron, which necessarily sells for a substantial advance in price over commodity materials. Naturally there was much introductory work to be accomplished and a large amount of sales resistance to overcome. As a basis for this development a system of Armco distributors was built. Responsible jobbing houses in important localities were appointed Armco

distributing agencies. Through lending them the necessary assistance and incentives, all their salesmen became Armco salesmen. In a similar way, salesmen for all the various Armco culvert and flume manufacturers, also began to talk Armco products over the length and breadth of the land. Thus was accomplished what would have been physically impossible for a single small sales force.

In the early days, the market for Armco products was principally through the building trade; and the logical channel was through the distributor, jobber, and dealer. In later years, however, these products have come more and more into demand by manufacturers for the fabrication of sheet metal products. In meeting this new demand, the same plan has been followed of encouraging salesmen for the manufacturer and even for the retail merchant to make use of the Armco selling arguments.

On account of the diversity and highly specialized nature of Armco products, it is of prime importance that the salesman be thoroughly conversant with plant and product. Therefore it has been found necessary to require prospective salesmen to follow the Armco general apprenticeship cooperative course. In addition, special apprenticeship courses have been organized for the salesmen of Armco culvert and flume manufacturers. These various activities comprise an interesting development in conjunction with the story of Armco publicity and collateral advertising.

During the period of America's participation in the World War, the selling organization was forced almost over night into new responsibilities and duties which tested severely its flexibility and stamina. Practically each order had connected with it a mass of details in connection with government priorities, transportation, and many other complex problems and situations arising out of the state of war. It was necessary for the sales organization to secure an altogether new class of orders to keep the mills running on the high priority war business and to protect our status under priority ratings so that nothing might interfere with the inflow of all-important raw materials. Fine diplomacy was also called into play daily in reassuring old customers that the company was not discriminating against them whenever it was necessary to fill orders of a higher priority rating. It is noteworthy that 49% of the men of the division entered their country's

service; and with but one or two additions the work was carried on by those who remained at their posts.

Up until this time the division had simply grown by accession and there was no well defined ideal of organization. The happenings of the last year of the war and the events following the signing of the armistice made more and more apparent the immediate need for a reorganization of the selling structure and a careful revision of sales policies. In working out the new plan two main ideas were uppermost.

First—All contact with customers, either by letter or in person, should be through the medium of the sales division. That division should be responsible not only for securing the order, but also for keeping in touch with its progress in manufacture and shipment. It should rest with the sales division to make certain that the material fully suited the customer's purposes and that his best interests are always served through the Armco organization.

Second—In order to insure real service to customers there should be a complete understanding and a most thorough-going, hearty cooperation between the sales division on the one hand and the operating or manufacturing division on the other.

Under the old regime, the sales division was held responsible for relations with customers up to the point where actual orders had been received. From that point responsibility was assumed by the order department which carried on all further correspondence and negotiations until the final shipment of the material. Both the order department and the claim department were under the jurisdiction of the treasury division.

The newly conceived scheme of organization represented an infinite amount of effort and study over fully a twelve-month period. It was finally put into effect in July 1919. The first step was the affiliation of the order department with the sales division. A little later the responsibility of handling all claims and complaints was transferred to this division. All of the details of reorganization were quickly worked out and within a few weeks the new structure was functioning efficiently, smoothly, and effectively.

The executive duties of the division are vested in the General Manager of Sales and Assistant General Manager of Sales.

The home office or headquarters organization is made up of eight separate departments and sections; namely, Export Department, Culvert and Flume Department, Sheet Section "A," Sheet Section "B," Blue Annealed Sheet Section, Armco Developments Section, and Order and Schedule Section.

The export department is in direct charge of and responsible for all of our business negotiations outside of North America. Its work naturally brings it in direct contact with many export and import connections throughout the United States, especially in New York City. For this reason one representative of this department is permanently stationed in that city. A brief outline of the growth of the export department is given in another chapter, together with a list of present overseas representatives and agents.

The inception and history of the Armco Culvert and Flume Manufacturers Association is of such importance as to require a chapter elsewhere in this volume. Its development represents an unusual and striking example of the success that can be obtained through proper organization backed by unselfish cooperation. This success has been dependent in no small measure on the discriminating advice and forward looking policies advocated and followed through by the culvert department. At present the department consists of a manager and one assistant.

The culvert and flume department is responsible for all relations of Armco with members of the culvert association. Many of the culvert companies have branched out into fields other than the regular culvert and flume lines; and are firmly intrenched in the manufacturing and distributing of numerous sheet metal articles such as roofing, grain bins, silos, corn cribs, tanks and troughs, irrigating pipe and accessories.

In addition to these expanding and enlarging responsibilities, the culvert department is constantly in cooperation with the Association in all activities, such as developing and improving new products and machinery, following closely state and federal highway activities and policies and rendering active assistance in the myriad problems which come up in the daily routine. The department is also sponsor for the culvert salesmen's apprenticeship course mentioned elsewhere.

The main sheet or tonnage sections are Sales Section A, Sales Section B and Blue Annealed Sheet Section. The diversity and highly specialized character of Armco products made necessary a very careful division as to the handling of these various products. This division between these sections is directly along parallel lines with the departmental organization of the operating or producing units. Hence each sheet section daily comes in constant and direct contact with the same mill departments, thereby securing the closest kind of cooperation.

Sales Section A is in charge of sales of all pickled sheet specialties, automobile sheets, alloy coated sheets, etc. Its direct contact is with the finishing department of the mill group. The sale of all black sheets, galvanized sheets, and roofing products, enameling sheets, and polished stove and jacket sheets is supervised by Sales Section B. The Blue Annealed Sheet Section is responsible for all blue annealed, tank plate, semi-finished products such as billets, slabs and bars, steel castings, conversion products, and by-products and therefore comes in daily intimate touch with the jobbing mill, blooming and bar mill departments, and steel foundry.

These main material sections, being in constant touch with the mills always have full knowledge of the condition of each order. They make tonnage allotments to the district offices and are in general responsible for all of the details in connection with the various products which they handle. They are also responsible for the handling of claims and complaints under the regulation and supervision of the sales management. They do not regularly come in direct contact with customers, the point of contact being through district sales offices. In short, the sheet sections are the intermediaries between the district offices and the manufacturing departments; they are fully conversant with the problems of each.

The Developments Section is in no wise a tonnage or material section, but is charged with general development and investigational work and plans and executes sales promotion campaigns. This section acts as a clearing house for information secured from the Research, Service Engineering, and other service departments; plans and prepares for convention exhibits, customers' sales conferences, educational campaigns, moving picture exhibitions, etc.; assists the publicity department in prepara-

tion of catalogues, booklets, and circulars; keeps in touch with all important technical and trade journals and with competitors' activities and products; follows up details and keeps records of all special sales campaigns.

The Order and Schedule Section is also purely a service section. It is responsible for registering orders, applying proper notations and classifications on them, and writing them up on mill forms. It checks prices, keeps contract and tonnage records, schedules material on the mills, issues invoices, and keeps records of claims and complaints. In addition, this section keeps up-to-date inventories of stock on hand and also collects and collates statistical records for the sales division. The order section does not come in direct contact with customers; its chief contact with district offices is through the medium of the material sections.

Along with the plant expansion program through the building of new East Side Works which marked the opening of the second decade of Armco history there was also a branching out of sales activities through the establishment of branch or district sales offices.

The first district office to be established was opened in Chicago on January 1, 1911, and is now located at 1208 Peoples Gas building. The district manager there has a staff of two salesmen and two stenographers located in Chicago and a resident salesman located at Omaha, Nebraska. This district is responsible for business with all customers in the states of Colorado, Wyoming, North Dakota, South Dakota, Nebraska, Minnesota, Iowa, Wisconsin, northern Illinois, northwestern Indiana, and eastern Montana.

The Pittsburgh district sales office, 432 Oliver Bldg., was established on May 1, 1911. The staff includes besides the district manager, one salesman and two stenographers. The Pittsburgh district comprises western Pennsylvania, northern West Virginia, the extreme southeastern portion of Ohio, and the three westernmost counties of Maryland.

The versatility of "Armco" Ingot Iron has made possible its development and conversion for a large variety of purposes, shapes and sizes which must be secured through outside mills equipped to roll these special forms. This development work has entailed a vast amount of detailed negotiations and this work is centered in the Pittsburgh

district office, assisted by the blue annealed section at the home office.

The third district sales office was established at Detroit on July 1, 1911. At present this office is at 1820 Dime Bank Building. Its staff consists of a district manager and assistant, a salesman and two stenographers. It is responsible for promoting the sale of Armco products in the state of Michigan, the extreme northwestern counties in Ohio and a small strip in the northeastern part of Indiana.

The year 1912 also marked the establishment of three district offices, the first of these being opened at St. Louis on the 15th of February. The office at 1120 Third National Bank Building is in charge of a district manager assisted by one salesman and one stenographer together with a resident salesman located at No. 1016 New York Life Building, Kansas City, Mo. The St. Louis district includes the states of Arkansas, Oklahoma, Kansas and Missouri, the extreme western part of Tennessee, a few western counties in Kentucky and the southern half of Illinois.

The Cleveland district office is in charge of the H. D. Cushman Company, commission representatives. Their representation, which has been continuous since July 1912, is loyal and efficient. They look after Armco interests in northeastern Ohio and Erie County, Pa.

On August 1, the last of the offices to be installed in 1912 was opened in room 1375, 50 Church St., New York. It is in charge of a district manager, two salesmen, and two stenographers, together with a representative of the Export Department and is responsible for business in the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut, northern New Jersey, eastern New York and northeastern Pennsylvania.

No district offices were opened in 1913 and but one in 1914, that one being at Cincinnati. The Cincinnati office is now at 1402 Union Trust Building and is in charge of a district manager, salesman, and two stenographers. From this office is covered the main portion of Ohio, the southern part of Indiana, the state of Kentucky, with the exception of the extreme western counties, the southern portion of West Virginia, and that part of Tennessee east of the Tennessee River.

A district sales office was opened in San Francisco in August 1915. It early was apparent that the require-

ments of that far distant region were of special nature and required separate and distinct methods of procedure. Consequently, The American Rolling Mill Company of California was incorporated in February, 1917, and has since been extremely active and efficient in entrenching and developing Armco business in California, Oregon, Washington, Nevada, Idaho, Arizona, Utah, New Mexico, western Montana, western Texas, and British Columbia. It is operated as a separate and distinct company, purchasing its supply of material from the parent company and handling directly all business with customers in its territory, with the exception of culvert and flume requirements. This company has a leased warehouse at 10th and Bryant Streets, San Francisco, where its offices are also located. Its organization consists of a president and general manager, two salesmen, two stenographers and two warehousemen. It carries a sizable stock of Armco products, together with certain Armco conversion products such as "Armco" Ingot Iron welding rods.

Exigencies of the war period were responsible for the opening of a district office in Washington, D. C. on the first of December 1916. During its life from December 1916 to February 1919 it served Armco interests in a most extraordinary and effective manner. With the cessation of war-time requirements it was found desirable to transfer this office to Philadelphia where it is at present located in the Widener Building and is in charge of a district manager with one salesman and two stenographers. This office is responsible for the states of Virginia, Maryland, Delaware, North and South Carolina, Maryland exclusive of the three westernmost counties, southeastern Pennsylvania, southern New Jersey, and the District of Columbia.

In a similar manner the Atlanta office during its three years' existence proved to be a real force in entrenching Armco in the South. This office was only discontinued in order to arrange a more effective and efficient territorial grouping, which was responsible for the removal of the Atlanta office to its present location in New Orleans.

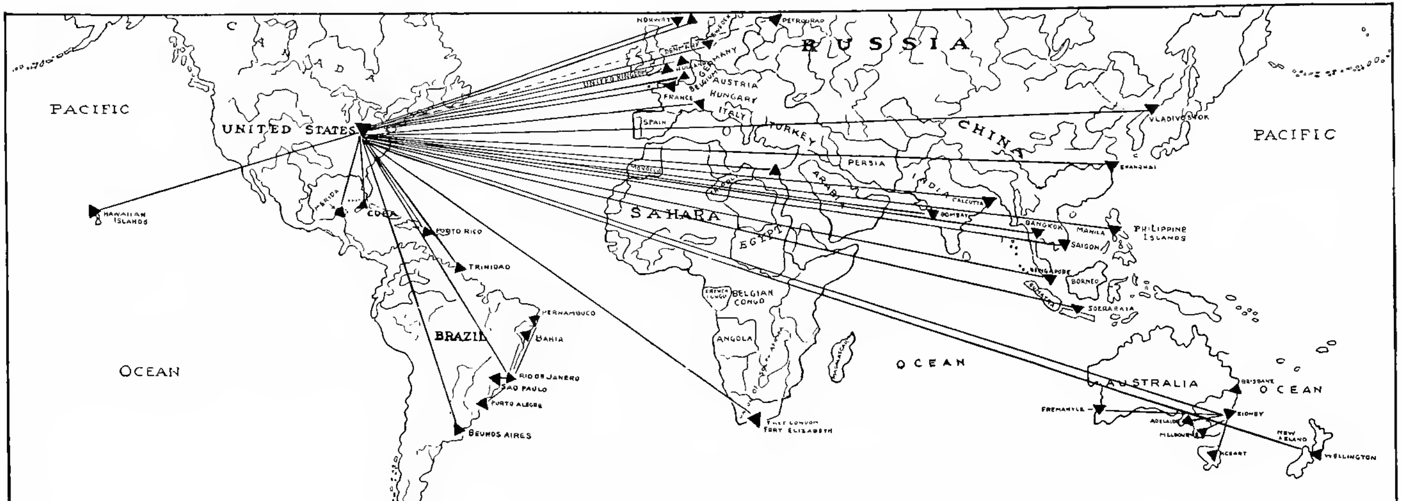
The second office established in 1917 was located at No. 401 Niagara Life Building and is in charge of a district manager, assisted by a stenographer. From this point the western part of New York and extreme northern counties of Pennsylvania are covered.

For some years Armco had a representative stationed in Canada, usually at Toronto, but it was not until July of 1919 that the Toronto office was established at No. 2 Colborne St. This office is responsible for Armco business in the Dominion of Canada: with the exception of British Columbia, and the Province of Newfoundland. A district manager and a stenogapher are located at this office.

In 1920 it was decided that a more effective territorial grouping could be secured by removing the district office at Atlanta, Ga. to New Orleans. On August 20, the new office was opened at 612 Hibernia Bank Bldg., where a district manager and a stenographer care for Armco interests in Louisiana, Mississippi, Alabama, Georgia, Florida and the state of Texas with the exception of the extreme western counties.

All of the twelve permanent district offices have enjoyed continuous existence from the date of their founding. They are the very heart and center of Armco selling methods and activities, and form the direct points of contact with customers and are directly responsible for all business within their territory. Each district manager is, so to speak, the ambassador of Armco in his particular territory.

Reaching from coast to coast and from the gulf into Canada the sales organization with its steady, healthy growth is representative of the development of The American Rolling Mill Co. as a whole. The past eight years have seen the establishment of twelve permanent district offices. The years to come should see an even greater development as the Armco organization gathers momentum and the real worth of Armco products is impressed upon the minds of the American people.



ARMCO OVERSEAS

1920

Chapter XII

The Growth of ARMCO Overseas

First Overseas Office in South America—Sketches of the Planting of Agencies—Brazil—Argentine—London—Hawaii and the Philippines—Holland and the Dutch East Indies—Russia—Scandinavia—Australia—New Zealand—China. License Arrangements.

UNTIL 1912 Armco "builded its house in the woods" as far as overseas business was concerned. It was fully engrossed with the problems of supply and demand in the United States, and gave no effort or thought to the enormous market lying beyond our borders. The world, perforce, first found its way to Armco's door.

Armco had made a substantial metallurgical advance; it had perfected a method of producing Pure Iron in quantities. Engineers and scientists the world over watched the development of Armco's method with keen attention, and in 1911 the first commercial manifestation of this interest in foreign lands came from a South American engineer in the form of orders for "Armco" Ingot Iron culverts. Other inquiries and orders of like nature followed, and Armco, looking over the markets of the world, realized its opportunities and its obligations, and took its place with those other representative American industries whose vision of service has embraced the entire world we live upon—not merely a fraction thereof.

Early in 1912 Armco took its first step into overseas markets. In January of that year one of the company's directors, Mr. F. H. Simpson, went to South America with one of the young members of the Armco sales force. They made a trip of investigation down the east coast of South America, through Beagle Channel, one hundred and fifty miles south of the Strait of Magellan, then up the west coast to Valparaiso and Chile. They returned to Buenos Aires over the Andes. During this trip an agent was appointed in Buenos Aires, and it was decided to open a branch office in Rio de Janeiro to push the sales of "Armco" Ingot Iron culverts primarily. The Armco salesman was left in charge; thus in Rio de Janeiro

ARMCO CULVERT ASSEMBLING PLANT AT RIO

in March 1912 was installed the first Armco foreign sales outpost in charge of an Armco man.

With this as a beginning Armco has steadily extended its influence, introducing its triangle trade-mark into country after country. Few are the trading posts it has established that have since been withdrawn.

A brief reference here will outline the spread of Armco's name over the world, and, later, some of the individual histories of the various foreign representatives will be dwelt upon with more detail.

The year following the establishment of the Rio de Janeiro and Argentine branches, Armco established its representatives in London. In the same year, in the main office at Middletown, a separate export department was formed, which was made responsible for the development of Armco's overseas trade and good will.

During the next year or two the American colonies of Hawaii and the Philippines were covered. Then an energetic business man from the Netherlands visited us and was given the Dutch East Indies and Holland to cover for Armco products.

In 1914 the export manager made a visit to Europe. He appointed agents in Austria, Russia and Norway. The last two representatives did good work as long as war conditions permitted, but later the Norwegian representative was the sole survivor of this trio.

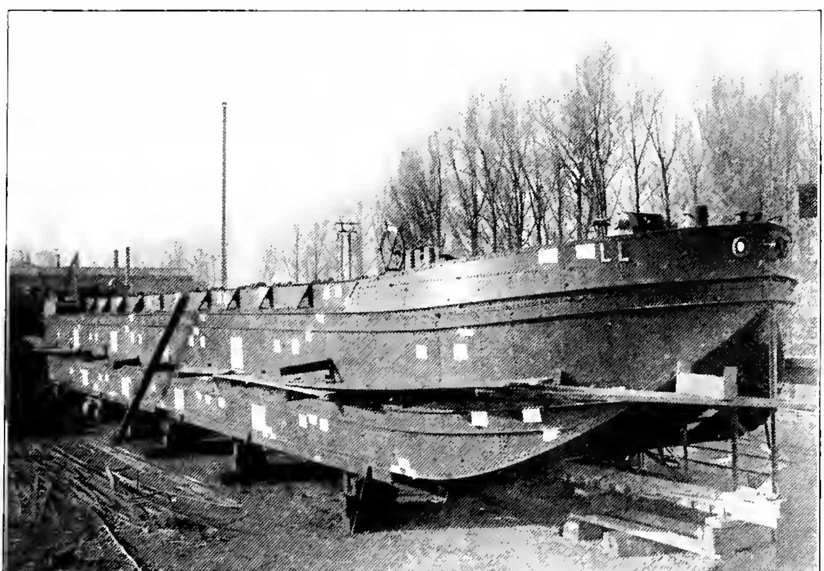
During the World War, Petrograd and Central Russia had been more or less cut off from the world, and in 1915 a separate representative was appointed in Vladivostok to cover Siberia. It was during 1916 also that the Armco Triangle was spread through the Orient by a trip of an Armco overseas man who appointed representatives on the Malay Peninsula, in Siam, in Indo-China and in New Zealand.

Then attention was turned to the European market which consumes large tonnages of specialty sheets such as Armco is best fitted to produce. To strengthen Armco's connection with this field, representatives were appointed in Italy, France, Belgium and Egypt.

For some years Cuba was covered direct from the main office, but with the armistice and the resultant boom in sugar prices, this market became decidedly important; so in 1919 an Armco man was sent to that republic.

Gradually through personal study and appointment of agents the mark of the Triangle was carried to Australia, Trinidad, Porto Rico, China, India, East Africa, South Africa, Mexico, Colombia, Sweden, Poland, Rumania and Latvia; in fact to all the world's important distributing centers.

In addition to Armco's efforts, the Armco standard is being carried abroad by other American companies:



Barge Lined With "Armco" Ingot Iron, Constructed in Holland, for Dutch East Indies

The Dixie Culvert & Metal Company, of Atlanta, Georgia, tells the story of "Armco" Ingot Iron Culverts and Flumes through Central America, the West Indies, Colombia and Venezuela. On the Pacific Coast, the California Corrugated Culvert Company is the fountain head of an energetic campaign for culverts and flumes of "Armco" Ingot Iron that takes in China, the Malay Peninsula, India, the Dutch East Indies, Australasia, the Islands of the Pacific, the west coast of South America and Mexico.

The value of Armco's high ideals in material and policies has shown most strikingly in the building up of its overseas organization. Quality products and quality policies appeal to quality men, and the volunteers who have enlisted under the Armco banner in every clime and on every continent, are of unusual caliber.

The individual histories of the various members of the Armco overseas family contain many items of interest, only a few of which can be mentioned.

The Armco Brazilian branch has lived through some trying days. During the first year of its career this office succeeded beyond expectations; substantial orders for Armco culverts were placed with the leading Brazilian railways. In late 1912 a well-known Brazilian engineer of splendid ability and character found in Armco, principles and policies in accord with his own ideals and joined our staff as joint manager of the Rio branch.

In 1913 an erecting plant was installed at Pont do Caju, on Rio Harbor, so that the Armco culverts might be made locally to eliminate the expensive ocean freight on the finished article and assure the local user of prompt supply of the best type of culvert.

In 1913 an Armco man direct from Middletown was sent to Buenos Aires to assist the Argentine representative. He helped keep this Armco connection alive during the severe financial crisis which seriously affected all of South America in 1913 and 1914, and even under these handicaps was able to introduce various Armco Ingot Iron products into this great potential market: probably the greatest single importer of galvanized iron sheets in the world.

Our British representatives had been active only a little more than a year when the great war broke out. Their staff entered British military and naval service almost to a man; yet they managed to keep in close touch

Armco Culverts under Forest Railway in Siam

with the home office and did much good work for Armco during the war period.

"Armco" Ingot Iron itself, went into war service in Great Britain even before America entered the war. British high-speed tool-steel had been made of Swedish iron. During the war Swedish iron for many reasons ceased to come to England in sufficient quantities to manufacture all the special steels required for the urgent demands of the war god. The British Isles were surrounded by the German sea pirates, and imports of every sort were curtailed to the famine point. It was necessary to find plenty of homogeneous pure iron, to find it quickly, and it was highly desirable to find a product that was manufactured in the United Kingdom itself. In this situation the British turned to "Armco" Ingot Iron, and, after many exhaustive and severe tests, carried out by Professor Ripper of Sheffield University in the very center of the high quality steel manufacturing district, a report was submitted to the Government showing that Armco Ingot Iron could serve the allied nations as a base for tool steel just as well as any foreign pure iron previously used.

The Shelton Iron, Steel & Coal Company, Armco's British licensee, who commenced making "Armco" Quality Ingot Iron in England early in 1914, turned out large quantities of this product during the last two or three years of the war.

The Armco quality material has found a special market in the tropical regions of the world—those districts where the corrosion of iron and steel is most destructive.

In these countries the engineers and builders, who have long been dissatisfied with the short life of galvanized steel, have turned to the galvanized "Armco" Ingot Iron roofs which assure them the long-desired service.

Armco culverts and flumes have also contributed most helpfully to the development of the roads and to the prosperity of various regions. The flumes have served not only to conduct water for irrigation purposes, but also to bring sugar cane for miles from the upland growing fields to the central grinding mills in the valley.

Illustrating the growing power of quality products in all sections, Armco's Netherlands representation is interesting. The energetic management of a company in Delft heard of "Armco" Ingot Iron, read the literature describing it, grasped the possibilities of this coming metal, and came to Middletown to obtain this product for sale in their own country and its East Indian Colonies. "Armco" Ingot Iron is now as well known in Holland, lying in the midst of the three great European iron and steel producing countries, as it is in its own home state.

Armco's Russian connection was established just as the war broke out. It did the best work it could. Several carloads of culverts were promptly shipped to its order, and through it, hundreds of miles of "Armco" Ingot Iron wire have been strung across the great Russian Empire. With the aid of our representative, the last large quantity of Russian railroad cars, sorely needed to replace those captured by the Germans, were shipped to the front roofed with rust-resisting "Armco" Ingot Iron.

All through the war, correspondence with the Russian Armco outpost was most difficult. With the ascendancy of the Bolshevik rule communications were broken off entirely.

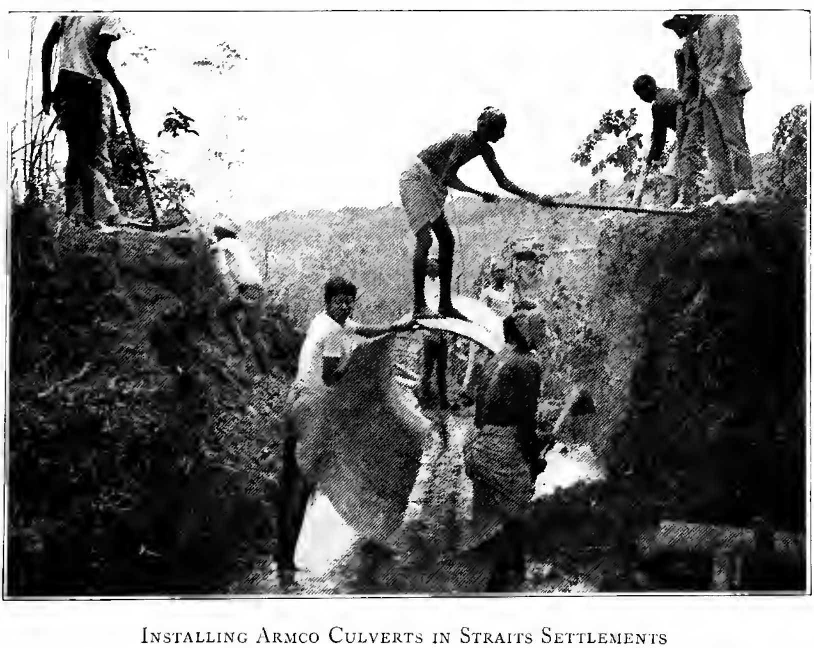
Although Armco's hold on Russia has been temporarily shaken by the Bolshevik reign, an Armco man has recently been established in Polish Warsaw, which is

considered the gate that will first open to the new commercial Russia.

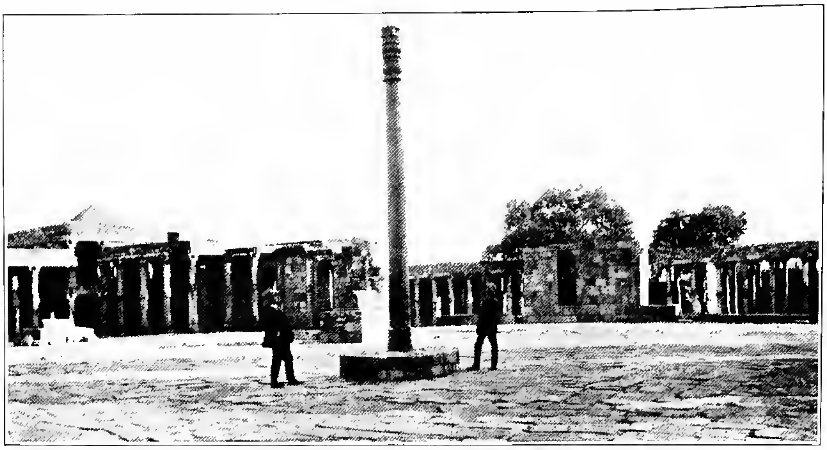
On the same trip that served for the appointment of a Russian representative, an energetic Norwegian firm was appointed Armco's representative in Trondhjem, Norway. Through this representative, "Armco" Ingot Iron was brought to the land of the famous Swedish iron. Ingot Iron in a most creditable manner withstood this test of close comparison. The Armco Triangle is now well known all through Scandinavia and steady orders come from this territory which knows the quality and advantages of Pure Iron as perhaps no other portion of the earth does know them.

An active Australian company, known as the Armco Iron Australian Agency, was organized and obtained the "Armco" Ingot Iron rights for development in the Australian Commonwealth.

The growth of this and all other overseas Armco organizations was at first somewhat restricted by Armco's inability to supply all the tonnage required; nevertheless, they have made the Blue Triangle the best known American brand on the Australian market—one which will hold its place even under the advantageous preferences given home manufacturers.



Installing Armco Culverts in Straits Settlements



Armco Representative Inspecting Iron Pillar of Delhi, India

Twelve hundred miles from Australia lies New Zealand where a former resident of the state of Kentucky came across "Armco" Ingot Iron and believed he saw in it a big opportunity. Through this agency in New Zealand, this territory has come to look upon the Blue Triangle as a mark typifying American sheet iron. From one end to the other of the islands the Triangle is known.

China first came to Armco by sending one of her own sons to study Armco at Middletown. He now handles Armco and Calco products and is introducing the Blue Triangle to this great potential market with all the advantages of first-hand knowledge of the products and the organization behind him.

Armco products are also well known in Siberia, Singapore, Siam, Indo-China, Italy, France, Egypt, Turkey, and Cuba. They can be found on the crowded docks of the cosmopolitan Siberian city of Vladivostok; they can be seen installed by the road builders of the Malay Peninsula and Siam where the elephant is the beast of burden. The manufacturers of Italy and France find that Armco specialty sheets stand the test in comparison with the best that the Old World can produce for electrical and enameling purposes. Egypt and Constantinople find the Blue Triangle in evidence. Cuba, Hawaii and Porto Rico the great sugar producers of the world, turn to Armco for the durable roofing their mills require.

Through license arrangements a group of manufacturers in the United Kingdom are helping direct the flow of the tide towards Pure Ingot Iron for rust-resisting purposes.

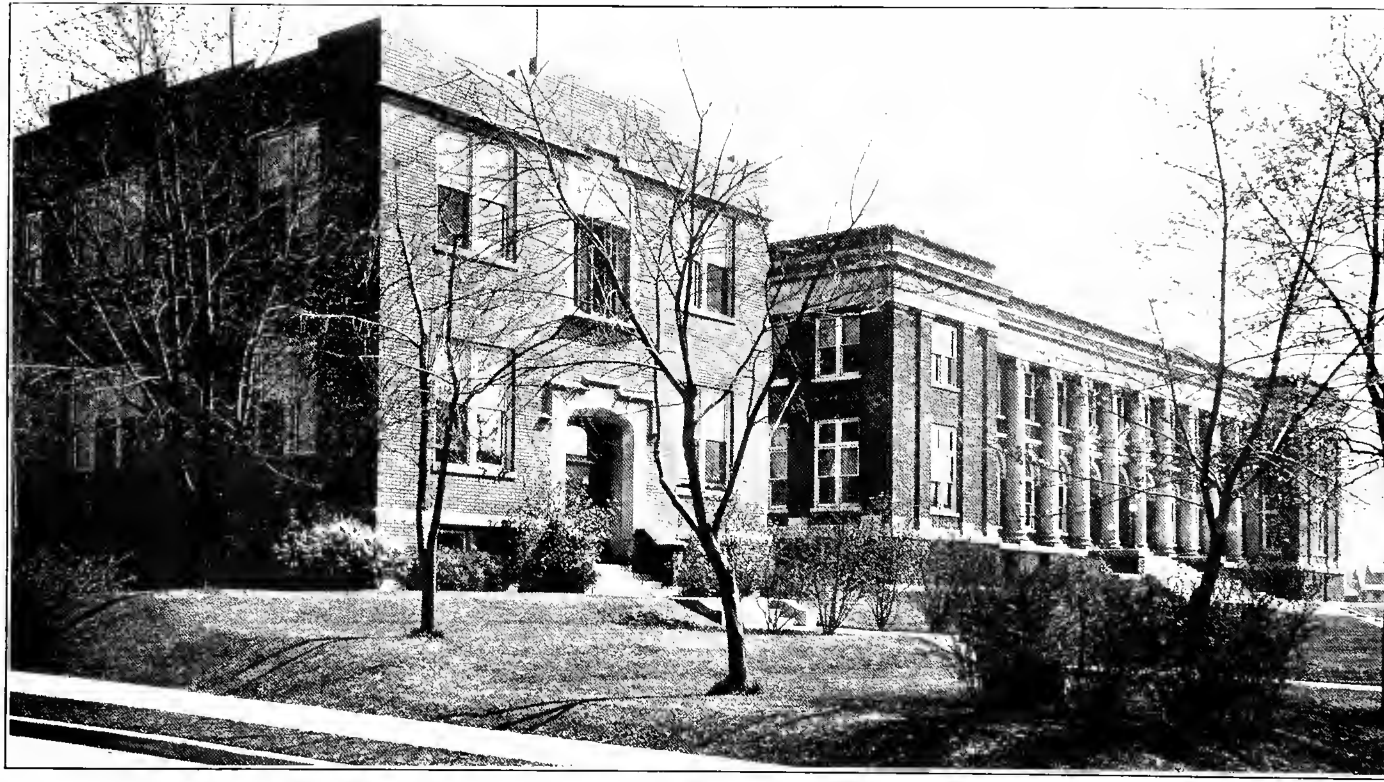
Of these the Shelton, Iron Steel & Coal Company is one of the old-line English firms that produce and sell coal, iron, and steel in Straffordshire, England. It operates its open hearth furnaces on hot metal from its own blast furnaces which, in turn, are only a few paces from its own coal mines and coke ovens.

In 1914 this company began the manufacture of "Armco" Ingot Quality Iron in its open hearth furnaces under license arrangement with the International Metal Products Company, and during the war served the tool-steel makers with this product. Since the war it has pushed more actively the commercial sales of Pure Ingot Iron and is now building up an interesting demand for "Armco" Quality Ingot Iron in most of the forms its mills produce; such as, bars, shapes, and plates. Shortly after the armistice was signed negotiations were recommenced with other British firms which had expressed their interest in "Armco" Ingot Iron.

In 1920 license contracts were consummated with the Whitecross Company of Warrington, Chester, producers of wire products; with the Scottish Tube Company of Glasgow, Scotland, tube makers; and with the Scottish Iron and Steel Company of Glasgow, operators of open hearth and puddling furnaces. The Whitecross Company and the the Scottish Tube Company, of Glasgow, have taken up the production and sale of "Armco" Quality Ingot Iron wire products and tubes and pipes with energy and enthusiasm, and will distribute these products through the United Kingdom and over much of the globe through their well developed export organizations.

The efforts of this group of licensed manufacturers of "Armco" Ingot Iron will be strongly felt, especially throughout the widespread British Empire.

The picture of Armco is an international, not a national one. Its materials are well known, recognized and traded in by all races and in all leading world markets. The growing momentum of its reputation and good will is based on a foundation as broad as the limits of this globe, but more than that in its export trade, Armco is not only establishing and strengthening its own structure against the adversities of the future, but it is taking its proper place in the international markets where honest dealing and careful service lead to mutual respect, cofidence and good will amongst men and nations.



Research Laboratory and General Office of The American Rolling Mill Co., Middletown, Ohio

Chapter XIII

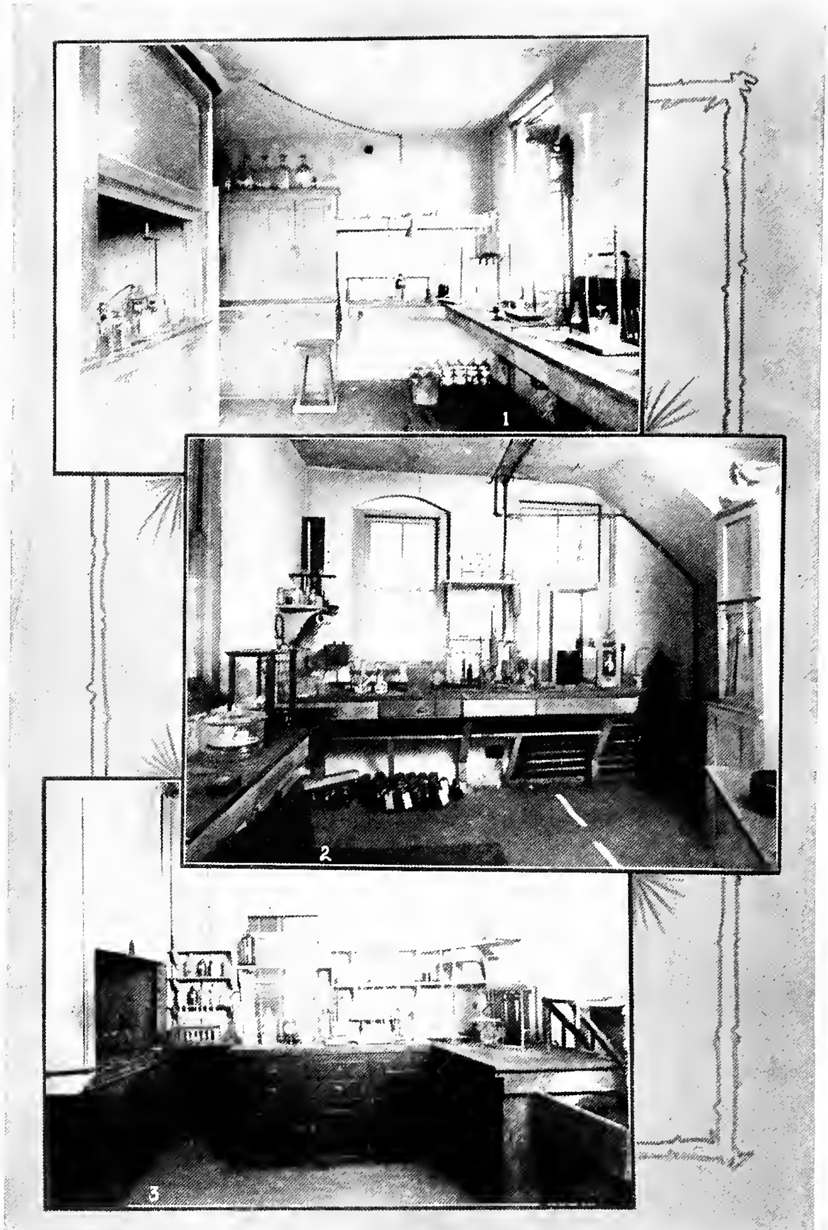
Research at ARMCO

Early History—Chemical Control Laboratory—Construction of New Research Laboratory—Chemical Research—Purity and Degasification—Standardization of Process by Scientific Control—Pyrometer Installations—Microscopic Section—Experimental Furnace Room.

FROM the date of its inception The American Rolling Mill Company recognized the importance of being strongly fortified by proper scientific guidance and also the necessity of continually making scientific investigations having a bearing on new products as well as improvements on products being manufactured, so that very early in its history Armco instituted scientific control and research in its manufacturing operations.

The building which served as the first chemical laboratory was originally used as the office of the superintendent of construction when the plant was being erected. This building, having served its purpose during the construction period, was remodeled and equipped as a chemical laboratory. Its original location was east of the Central Works mill in order to render access to the laboratory from the open hearth department more convenient. The building was a very modest frame structure. In addition to its use as chemical laboratory, one of its rooms also furnished office quarters for the superintendent of the open hearth department and the superintendent of the rolling mill. From the very nature of the case this building became the rendezvous of the operating management and many of the early problems and their subsequent solution were worked out as the result of investigations constantly being made, followed by the conferences and discussions of those persons responsible for the proper conduct of the plant.

About fifty feet south of this chemical laboratory, in the same mill yard, was located the electrical department headquarters and store room. This building was even more modest than the chemical laboratory, but for several years it served a very useful and important purpose.



Control and Fuel Laboratories

Finally it was abandoned and torn down when subsequent developments and necessities rendered a more spacious building necessary.

In the fall of 1903 considerable experimental work was carried on in connection with the development of grades of steel possessing properties suitable for use in the construction of dynamos, motors, and transformers. The electrical testing of these grades of steel was at that time conducted in a corner of the room on the second floor of the main office building.

In the year 1904 a new building measuring sixty feet long and forty feet wide, was erected. This building was a one-story brick structure, divided by a solid brick partition, the north half being used as a store room and the south half furnishing necessary quarters for an electrical steel testing laboratory and an electrical repair shop.

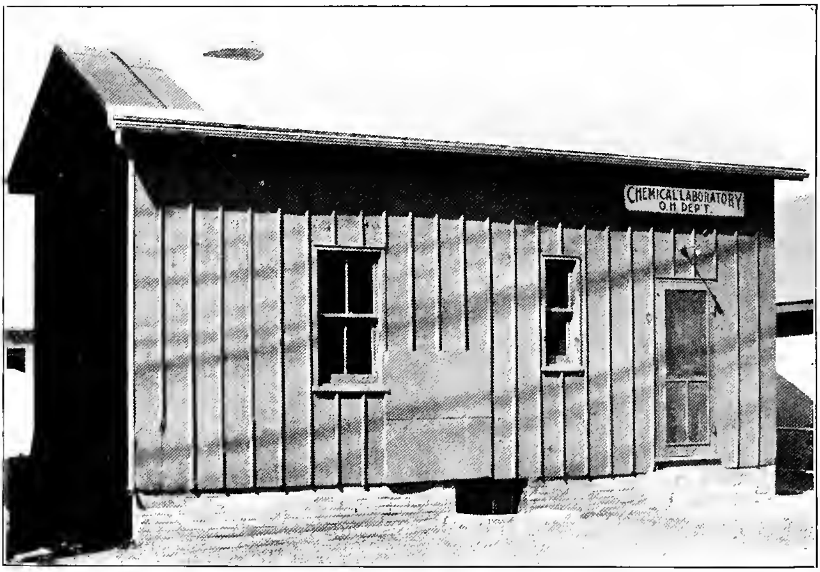
About the year 1908 a second story was added to this building. The demands of the electrical laboratory had rendered this addition necessary, and the additional space gained permitted a decided expansion of the electrical testing laboratory, the greater part of the second floor being devoted to this purpose. At this time a considerable addition had been made to the electrical testing apparatus as compared with that employed a few years previous. A new type of permeameter and a core loss tester had been installed. During this period much time and money had been spent in the further perfection of high grade electrical sheets in order to meet the increasing demands of electrical engineers and manufacturers and designers of electrical apparatus.

About this same time the chemical laboratory, previously mentioned, was moved from the east side of the mill yard to the west side of the mill building directly back of the open hearth department. This building, considerably modified and with some additions and improvements, is in use at the present day and serves as the office of the superintendent of the open hearth department of the Central Works, also as a chemical control laboratory for the analysis of the heats made in the open-hearth furnaces at the Central Works. This laboratory, as at present used, is simply the control chemical laboratory in connection with furnace operation, and the general scope of the work conducted here is different from that done in the central research laboratory.

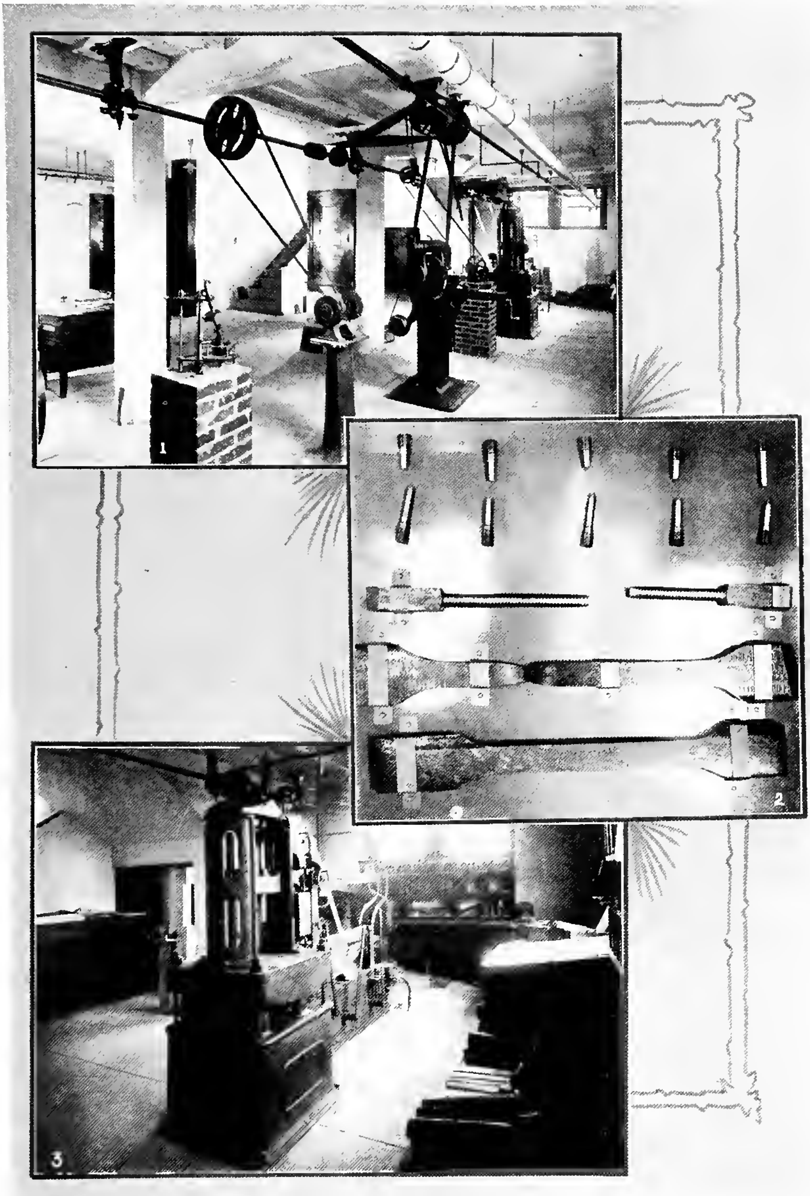
With the development and growth of the company, it was more and more realized, as time went by, that greater facilities in the way of research laboratories would add to the efficiency of the company and enable it to accomplish many things with rapidity that without this equipment would be difficult and slow of attainment. It was decided that the time had come when more concentrated attention must be given to the scientific study of iron and steel in order to serve the demands of the public.

In the latter part of 1909, practically simultaneously with the beginning of the construction of our large East Side Works, a building of fire-proof construction was erected on the east side of Curtis Avenue opposite the main office building of the company, the building being devoted almost entirely to research work and certain other high-character investigational and control work which properly belong to such an institution. This building is a three story brick and concrete structure forty by sixty feet.

The basement is abundantly lighted and well ventilated. In it are located the physical testing apparatus and machinery necessary for the preparation of samples for testing purposes. On the first floor are the offices, electrical laboratories, standards room and heat-treating department.



First Mill Office and Furnace Control Laboratory



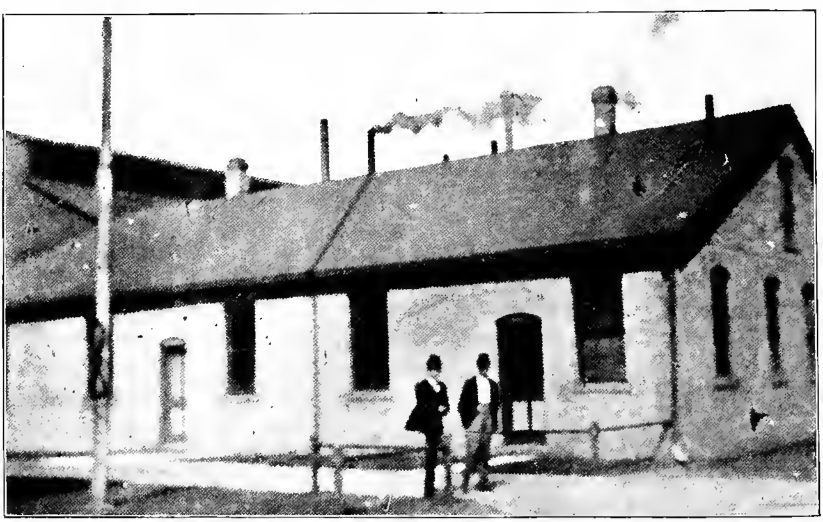
Physical Testing Laboratory

On the second floor are the main chemical laboratories, microscopical laboratories, and office of the chief chemist.

The research department not only undertakes research work to improve the quality of Armco products but it is constantly busy in the general control and supervision of the quality of the product. Much of the actual work done is accomplished in the open hearth control laboratories under the direction of the research department, which are located near the furnaces at each plant. At these laboratories every carload of material entering into the production of Armco products is carefully analyzed.

A sample of each carload of limestone, iron ore or pig iron received is taken in such a manner that it will be representative of the carload. This sample is then analyzed, for only by control of raw materials can uniformity of product be secured. The control laboratories are also responsible for the chemical analysis of the heats in the furnaces. Before a heat is tapped the chemist takes a sample of the metal and analyzes it. Should the analysis show that the iron or steel does not meet the specifications it is rejected and used for other purposes.

The tests involved in these two processes are in the main chemical tests having to do with the determination of the impurities in the metal. They necessitate large and well-equipped chemical laboratories at each works and an even better equipped general chemical laboratory in the



Armco Laboratory, Repair Shop, and Store Room in 1903

central research building where difficult tests may be run and service given to customers in solving their problems, for giving service to customers is one of the very important functions of the research department.

The first step in the analysis of iron or steel is usually the drilling, or shaving of the sample in order to secure a finely divided sample which can easily be dissolved in acid, for it is not until the sample is in very small particles that chemical tests can be made. In most cases it is dissolved in acid as the first step in the determination of the presence of a certain impurity. Then the necessary reagents are added, and the required filtering, washing, heating, titrating, etc., as the particular test may demand, are done until the final determination is complete.

The laboratory in which these operations are carried on is fully equipped with the very latest scientific apparatus for the conducting of the most delicate tests. Its general plan and structure are of such excellence that it served as a model for government chemists in the erection of new industrial chemical laboratories during the World War.

The methods used by the Armco research department in the testing of iron and steel have been collected into a volume describing research practice at Armco. Representing as it does an exceedingly complete and up to date study of the analysis of the ferrous metals, it has become a text-book in many technical schools where this problem is given special attention.

The study of the heat treatment of metals is an important part of the research work at Armco. It is probable that the greatest advance which has been made in the metallurgy of iron and steel in recent years is the development of heat treatment upon a scientific basis. It has not been a great improvement in the art made at a single step by a single invention or discovery, as some of the improvements in the past, such as the Bessemer converter and the Siemens regenerative furnace. But scientific heat treatment has been a gradual development, the result of much painstaking investigation and research upon the part of many metallurgists. The fuller understanding of its principles and the broader application of them has resulted in higher quality in iron and steel products than was formerly thought possible.

The thermoelectric pyrometer equipment which The American Rolling Mill Company has adopted as standard

for plant installations consists of base metal couples, and indicating and recording potentiometers for taking millivoltage readings. This base metal thermoelectric equipment is suitable for continuous service at all temperatures up to about sixteen hundred degrees Fahrenheit. For temperatures above this, rare metal couples or other types of equipment are used, such as optical pyrometers, which will measure temperatures from twelve hundred to four thousand degrees Fahrenheit.

The research department is equipped with the latest and best equipment and accessories for the microscopic examination of metals. The microscope has proved itself invaluable to the iron and steel metallurgists because of the information it discloses as to the physical structure of metals. The specimen for microscopical examination is first ground on an emery wheel until the surface oxide, and other surface blemishes have been removed and the specimen is flat. The use of finer and finer grinding mediums, each applied at right angles to the previous one finally gives the microscopic sample an almost mirror-like smoothness. The sample is then etched with acid and examined with the microscope which reveals the grain structure to the minutest detail. The extended use of the microscope has been linked closely with the development of heat treatment, for only by means of the microscope can the structural changes produced by heat treatment and annealing be observed.

The physical testing section of the research department is well equipped for carrying out all varieties of physical tests on iron and steel products as well as other materials when necessary. In this department the ability of the metals to withstand the impact and jars of the service under which they are to be put; the effect which gage, annealing temperature, grain size, and other factors have upon drawing qualities of the metal; and other problems relating to their physical strength in various directions, are determined. This equipment consists of the more usual testing machines and several of the more unusual ones. The following is a partial list of the equipment:

One 100,000 lb. Riehle Universal Testing Machine.
One 30,000 lb. Riehle Universal Testing Machine.
Two Hydraulic Brinnell Hardness Testing Machines.
Several Erichsen Draw Testing Machines.

One Landgraf-Turner Alternating Stress Testing Machine.

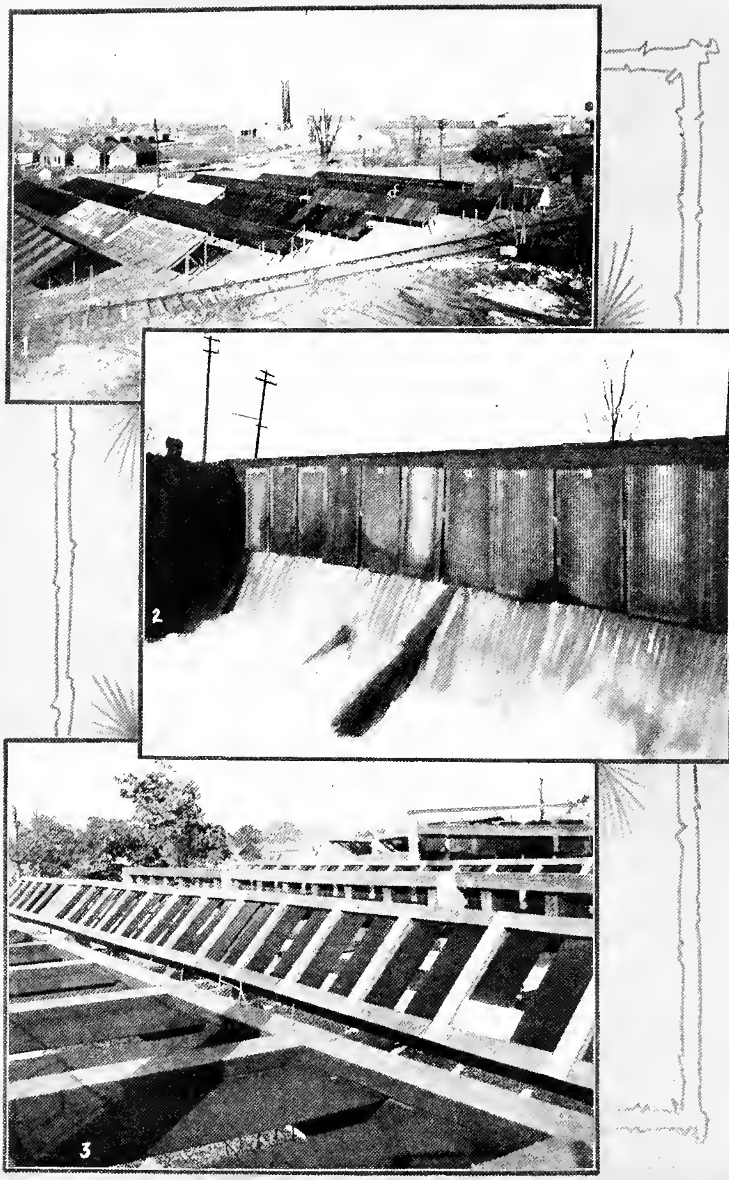
Several Bend Testing Machines, Scleroscope Hardness Testers, as well as several special testing machines designed for special purposes.

The experimental furnace room is the section of the research department where the preparation of experimental alloys is carried out on a small scale, and annealing and heat treating experiments are made. The room is fully equipped with such furnaces as are necessary for this work, as well as with pyrometers for accurate control of temperatures.

The furnace equipment which is all electrically heated consists of a Hoskins crucible furnace of the carbon resistor plate type, a Hoskins muffle annealing furnace, and a small arc melting furnace. It will conveniently accommodate a No. 18 graphite crucible and will melt without difficulty forty to fifty pounds of pure iron. With this furnace any alloy or series of alloys may be prepared in large enough quantities so that the physical, chemical, and magnetic properties may be determined. It is possible also to forge the small ingots into various shapes to determine the forgeability of the metal. The small ingots may even be rolled into sheets to determine the properties of the metal in sheet form.

The claim made for "Armco" Ingot Iron is that it "Resists Rust." In order to determine from a practical point of view, the resistance to atmospheric corrosion offered by iron and steel with varying chemical analysis, the research department maintains extensive proving grounds where the sheet metal is actually exposed to the weather. An impartial record is kept of the resistance to corrosion offered by the different sheets, and this fact, taken in connection with the knowledge of their chemical content, makes possible the acquisition of accurate and authoritative information in regard to the action under atmospheric exposure. Many other tests are also made under ground or other service conditions.

The organization of the research department consists of men of college training and experience in the various branches of work which fully equip them for this kind of industrial scientific control.



Testing Yards at Armco

The American Rolling Mill Company has throughout its history specialized in the production of iron and steel of high quality and unusual properties. This policy has necessitated careful scientific control of process and pioneering in the development of new products. In this very essential work the research department has carried the responsibility in setting the high standards which guarantee the Armco Triangle as the mark of quality.

Tapping a Heat

Chapter XIV

Service Engineering at ARMCO

Experimental Work in the Field—Conversion Work—Records of ARMCO installations—Supplying of Sample Materials—Helping the Customer in Manufacturing Difficulties.

WHEN The American Rolling Mill Company decided to manufacture high grade special sheets it became necessary to have a department to inspect and pass upon the finished product. For this purpose, an inspection department was formed during the year 1911. This was an independent department that reported to the management, until May 1916 when it became a part of the operating department.

The management desired to have a department free and unhampered for service engineering problems. This desire led to the creation of the service engineering department, which could closely cooperate with the operating, sales, order, claim, and research departments of the business.

To the service engineering department was given field work on experimental material with the idea of taking every precaution in the development of new material for specific purposes; not to go too fast but carefully to feel the way. The service engineering department's close contact with all the consumers of Armco products enables it to collect much valuable information along these lines and to give information as to the possibilities of the demand for a new product. The department makes arrangements to witness the working of the new samples in the shops of customers and then reports the results to the research department. If results are satisfactory from material which has been prepared under the direction of the research department, a small heat is made and larger quantities of this particular product are placed in the hands of those who are interested in it.

The service engineering department has charge of all outside Armco Ingot Iron conversion work. Many demands are made for Armco Ingot Iron in shapes and

forms that Armco does not manufacture; i.e., bars and large plates, merchant shapes of all kinds, rods, wire, nails, nuts, bolts, pipe, tubes, skelp, hot and cold rolled strip, etc. Although this kind of business has not been particularly solicited, a real demand has forced Armco to supply Ingot Iron in these various forms. The critical range in Armco Ingot Iron necessitated personal supervision over the heating and rolling of all these different products in the customers' plants. As a general proposition the slabs or billets for these conversions were rolled at the plants of The American Rolling Mill Company, but at times ingots were sent to other plants for conversion requirements. The service engineering department has exclusive charge of all conversion work of this kind and has educated hundreds of workmen in outside mills as to the proper heating and rolling of Armco Ingot Iron.

In the files of the service engineering department are the data and story, and in many cases the photographs, of all important Armco Ingot Iron installations. The work of following up and checking the service records of these installations from year to year falls under the work of this department and the work is carefully and painstakingly performed. As each new and important installation of Armco Ingot Iron is made it is reported to the service engineering department. Copies of the orders entered on the mill are noted and this department immediately arranges to follow through the mill. Complete records of the material are kept during succeeding years, to learn just what degree of service the iron is giving. The records of this department, especially as they have to do with actual service installations of Armco Ingot Iron, grow more valuable year after year.

Not the least of its very valuable work is the service that this department renders to the customers of Armco by a thorough study of their many requirements and by rendering prompt assistance whenever assistance is needed. When a customer reports trouble in the manufacturing process the service engineering department immediately gets in touch with him and personally investigates actual conditions to determine whether or not the material or his methods are at fault. Frequently the latter is found to be largely responsible for the failure of the material. If no fault with the customer's practice is found, samples of the material are brought back to the research department for

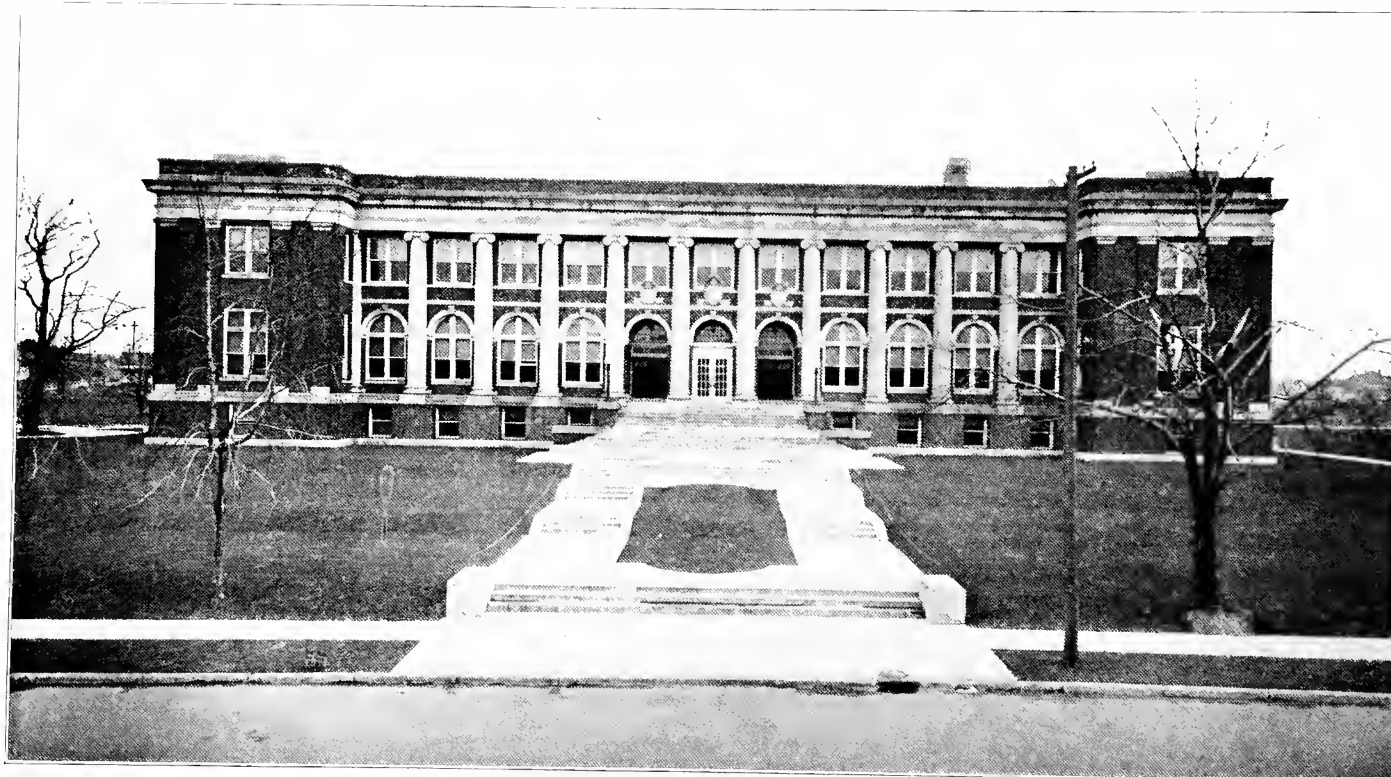
investigation. In this way the reason for the failure is generally revealed and remedied. The customer welcomes this cooperation and assistance; thus much valuable information and experience are obtained. This first-hand information concerning what is most required for the customers' special needs, especially in the case of spinning or drawing operations, is very valuable to the operating department.

In the files of the service engineering department is kept a complete record of all samples sent out, together with the purposes for which they were sent, so that a similar stock can be supplied on any orders later received.

All samples of material requested by the various departments are handled through the service engineering department. When these samples are subjected to any test the results are reported to the service engineering department. This report then becomes a permanent record so that if, years after, Armco is requested to furnish the same grade of material, the service engineering department is able to inform either the sales or the operating department as to just what grade of material should be made.

A record of the customer's requirements, his equipment and working organization, is also made, thus enabling us to accurately judge the limitation of the products furnished. The service engineering department maintains a separate record of the many grades of material made by Armco, showing the purpose for which the material is used and the degree of success.

The organization of the service engineering department consists of the director, an assistant, together with file clerk and stenographer. Notwithstanding its small number, the service engineering department is an important unit of the Armco organization. Many complex problems fall within its scope—problems that arise in customers' plants as well as our own. In any case the difficulties must be overcome. And so it is seen that the function of the service engineering department is to assist in every way it can in the development of Armco.



Main Office Building of the American Rolling Mill, Middletown, Ohio

Chapter XV

The General Office Organization

Early Development—The Accounting Department—Office Messenger Service—ARMCO Messengers' Club—New Office Building—Office Secretary—Office Manager's Division—Transcribing Department—Filing Department—Print Shop—Telephone and Telegraph Facilities—ARMCO Office Forum.

THE growth of the general office of Armco has kept pace with that of the company as a whole. The Company's first office was a small temporary frame building which was used until the first permanent building was ready. However, for most of the first seventeen years of Armco's existence, the office work of the company was carried on in what is now the training department directly across the street from the present main office building.

On New Year's day, 1901, the office force of the Armco family comprising five persons, including Mr. Verity and Mr. Phillips, spent the day putting the house in order and in clearing the decks for action. From this beginning of only five persons the office force of The American Rolling Mill Company has grown until now it normally comprises about three hundred persons.

The accounting department began as a one-man department in a small space in front of the vault on the first floor of what is now the old office building. One man acted as bookkeeper, cashier, and paymaster. Adding and book-keeping machines were then unknown. All calculations were done mentally and in long hand, for it was not until 1905 that the first adding machine was purchased. From this small beginning the accounting division has grown with the business. The cost, credit, cashier, and accounting departments have all been gathered under the head of the Treasury Division for administration. Together they occupy the whole front and one side of the second floor of the office building in place of the single desk with which the department started.

These departments are fully equipped with the most modern mechanical accounting machines, which have

eliminated much of the drudgery attendant upon keeping books before the invention of these improved devices.

Until 1903 there was no purchasing department, all purchasing being done by the president and general manager. Indeed in those days the executive officers were directly responsible for practically all the business of the company. Mr. Verity opened all the mail and he and Mr. Phillips divided the letters between them for reply. Mr. Phillips as secretary of the company looked after the sales, handled all sales correspondence, and called on the trade in various sections of the country.

A little later on, a Middletown high school boy who is now manager of the Detroit office, was employed to help out with some of the detail work in the secretary's office. It was his duty when he first came to carry the mail back and forth from the post office. He used a carpet sack which he threw over his back, but as time became more precious the company bought a bicycle for him in order to speed up the mail. Later on a horse-drawn bus was purchased and used for mail instead of the messenger boy and a bicycle. This bus also carried the office employees to and from work. These primitive methods of transportation have been supplanted by several automobiles which are used to take the mail to the post office, to carry interplant mail from one plant to the other, to carry special messengers, and to meet customers and other guests of the company.

In August 1906 a second high school boy was added to the forces as messenger and general utility boy. He is now the assistant general manager of sales, but at the time he was employed his principal duty was to wrap samples to mail to customers. In the present office organization four boys are employed as messengers. These boys, with the messengers from the East Side Works, have organized into a unique organization, the Armco Messengers' Club. It has its regular officers and meets every two weeks for the consideration of matters affecting the job the members are now in and their preparation for the job ahead. The office manager and the chief clerk of the East Side Works are associate members. The two men who started in Armco as messenger boys and have risen to positions of prominence in the company, the assistant general manager of sales, and the Detroit district manager, are honorary members.

Board of Directors' Room and President's Office

In June of 1918 the greatest single step taken by the office organization was made when it moved into its new building across from the Central Works. This large office building admirably combines the qualities of efficiency, size, and beauty. It is of a light reddish brick trimmed in white stone. Across its front extends a colonade of ten Grecian columns extending the height of the two stories.

The building has an abundance of light from windows both on the outside and from two courts in the interior of the building. In addition there is an exceedingly complete indirect artificial lighting system. A ventilating system supplies fresh air of a comfortable temperature in both summer and winter.

In addition to the commodious offices which are provided for every department, the new office building contains many service features for the use of the employees. Occupying the very center of the first floor is an auditorium with a seating capacity of approximately four hundred and fifty persons, which is used for company meetings and for community entertainments regularly held there through the winter and on the lawn outside during the summer. On the second floor is a rest room in charge of a nurse for the use of the girls. A club room for the use of the men after office hours is to be found in the basement where also is located a cafeteria which serves meals to Armco employees and visitors.

In the old office building a telephone girl in the main lobby extended the courtesy of greeting and introduction to the customers, visitors, and guests of the company who entered the office. However, the nature of her work made it impossible to extend the full measure of courtesy the company wished to show its visitors. In the lobby of the general office building today is to be found the desk of the office secretary whose sole duty it is to see that every one is received in a gracious manner. She enters on her list the visitor's name, address, the firm he represents, and the name of the person to be seen, after which she makes an appointment by telephone.

If it is necessary for the visitor to wait he is offered a daily paper or a magazine. If the delay should be long the office secretary makes a second call to discover its cause and informs the visitor that he may know that he is not being kept waiting longer than is necessary. A waiting

Men's Club Room, Lobby and Cafeteria at Armco

room adjoining the spacious main lobby is always at the disposal of all callers. On the library table are the latest magazines and a telephone is close by. In case the visitor prefers to devote a few minutes to special work of his own he finds a quiet place provided for him.

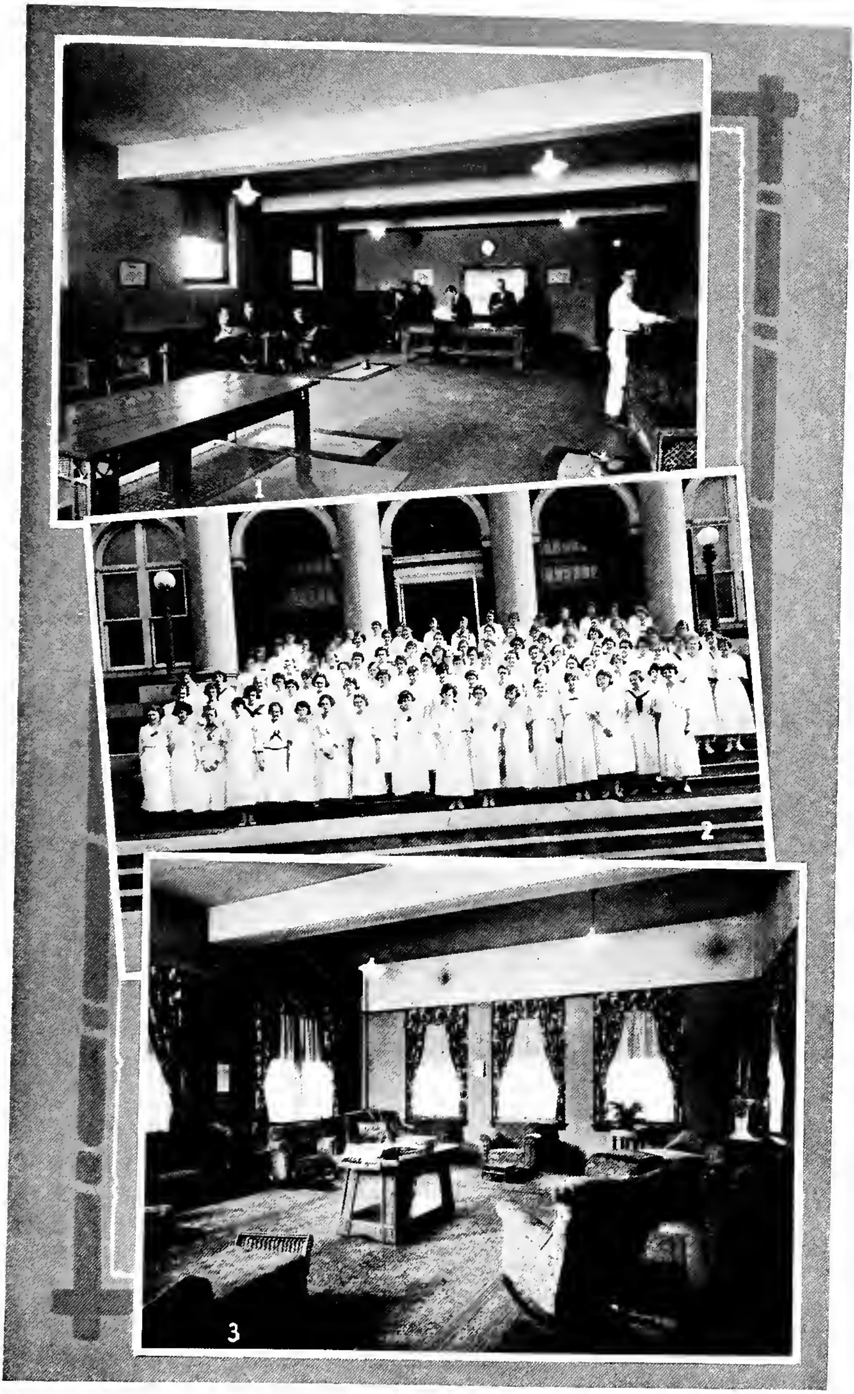
The first impression a caller receives is usually the most lasting so that the prompt and courteous attention which the office secretary gives to all who pass her way is making a real reputation for Armco among its visitors.

Until January 1912 office management was not a distinct division of the company's business but as the business grew the management saw the need of placing all the service work of the office under the head of one individual who would be responsible for handling the various service departments in such a manner as would best serve the other departments in the general office. To this end the work of systematizing the service departments was begun and material changes have been made in separating and expanding these departments as the growth of the business has made necessary and the increased facilities of the new office building have made possible.

Originally two girls were quite enough to open the mail. Closing the mail was done by the stenographic department after the girls in that department had finished their letter-writing for the day. Now the incoming and outgoing mail each amount to about fifteen thousand pieces of first class mail a month; consequently more efficient methods and appliances are necessary to handle the vastly increased volume. A separate mailing department has been established where letters are opened by a machine which slices off the merest fraction from the edge of the envelope without cutting the letter inside. The mail is then sorted to the various departments as in a post office and delivered by messenger.

In a cabinet at one side of the room are envelopes already addressed to the firms and offices with which there is a great deal of correspondence. The outgoing letters from the various departments are allowed to accumulate during the day, and then all of those going to one firm are sealed in a single envelope. Not only are letters opened by machinery but the envelopes are sealed by a machine which moistens the flap and fastens it down.

All copying in the early days was done on impression books and a little later by the rotary process, but both



Recreation Rooms, Girls Club and Rest Room at Armco

of these methods were so slow and inefficient it was quite usual for the stenographer to continue at work until 6.30 or 8.00 p.m., or, to go home to supper and come back to finish the day's work. From this crude and duplicating method of handling correspondence, the stenographic department, now known as the transcribing department, has developed into one of the largest departments in the office, using the most modern and efficient methods of handling the immense amount of work necessitated by the business of a large corporation.

All duplicating work is handled today in the print shop. This shop, equipped with multigraphs, mimeographs, addressographs, graphotype machines, and a real electrically driven job printing press now turns out about three million sheets a year.

The filing department formerly served only the sales and purchasing departments, but since moving into the new office building its files also serve the auditing, claim, credit, export, publicity, traffic, and office management departments. With a centralized filing system the filing department serves the various departments in a most efficient manner, the delays in obtaining correspondence under the old system being reduced to a minimum. In addition to the actual filing of the correspondence, each letter having an important subject is cross-indexed, which greatly facilitates the location of letters written over a period of years. More than twenty thousand letters are filed and about three thousand requests for correspondence from the files are handled by the filing department each month.

In the fall of 1921 the telephone system, which, since the removal into the new building, had placed a telephone on practically every desk connecting all departments of the plant with one another and with the city, was further improved. An automatic system was installed and the routing of wires was changed so that for their full course they were on Armco property. Formerly six day-operators and two night-operators were required but with the present system only two operators are required during the day; but by a special arrangement with the Middletown Telephone Company it has been found possible to dispense with night operators altogether.

For a long time all telegrams were sent and received by telephone, a method which could not be continued after the

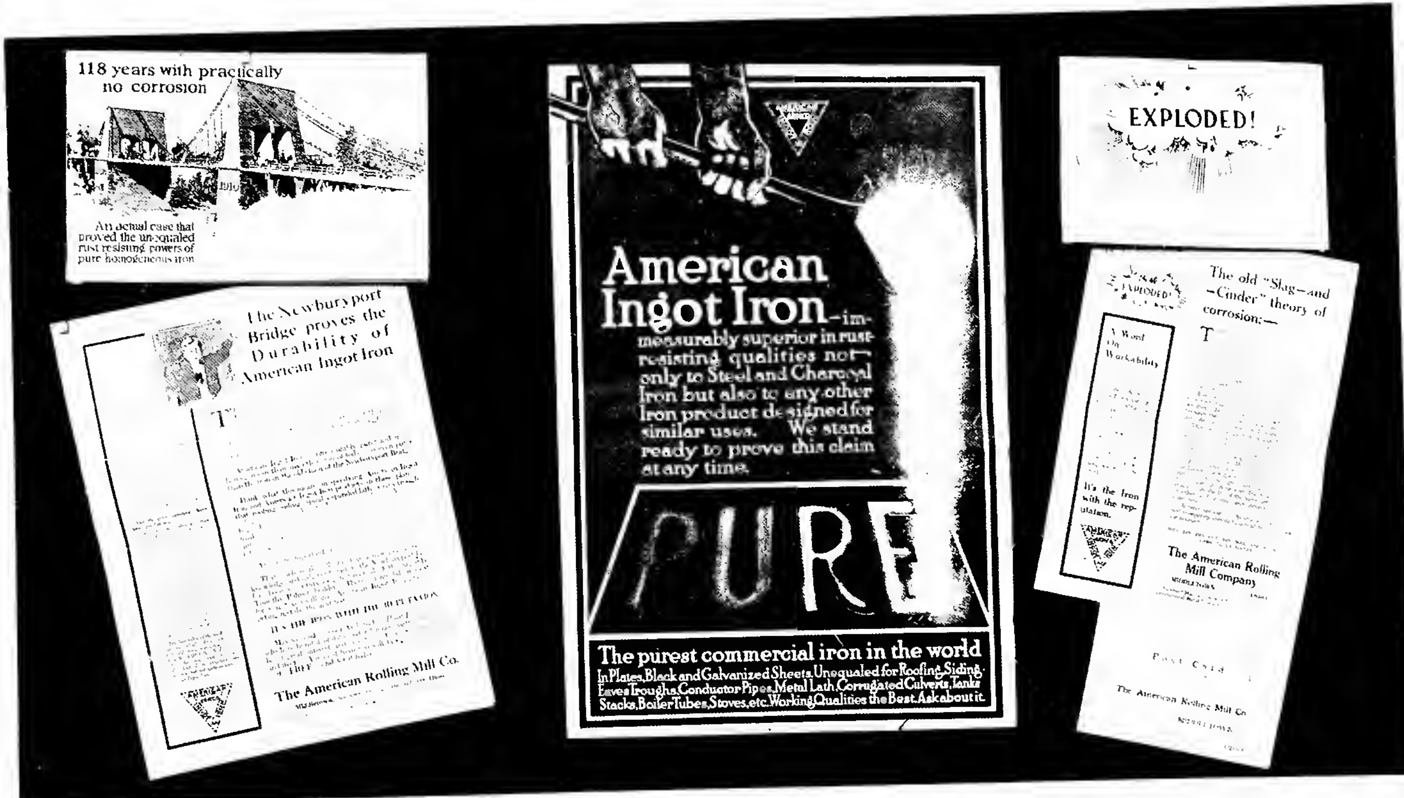
volume of business largely increased. Telegrams received and sent now amount to more than two thousand a month in addition to the cablegrams. To handle this business a telegraph office was installed in the general office building and a direct wire to the Cincinnati office of the Western Union Telegraph Company was secured. This placed Armco on a direct route to all the principal cities at a great saving of time over the former method of relaying through the Western Union's Middletown office.

For some time prior to 1919 the office organization had felt the need of a place and time in which discussion could be had of the various problems affecting the work of the office force both as an organization and as individuals. So in January of 1919 a committee was appointed to direct the Armco office forum. On every alternate Tuesday morning all the members of the general office organization assemble in the auditorium of the general office building to hear the reading of a fifteen minute paper on some subject of interest to the organization. After the reading of the paper a general discussion ensues.

Copies of the papers are multigraphed and distributed to each member of the organization, and, at the end of the year, these papers are collected into an attractive volume.

The forum is defined as "A Medium of Exchange of Ideas and Opinions and of the Dissemination of Useful Information." In one year the elements of "Armco Spirit" were discussed, and, in another, direct problems of office organization and management. The forum has been a very effective instrument in the unifying of the office force and the development of that spirit of cooperation which makes for the highest individual and collective efficiency.

Like every other part of the Armco organization the general office has passed from the simple methods attendant upon a new and struggling enterprise to the present efficient methods demanded by an increased volume of business. Its high morale and loyalty to the Armco ideal of "Quality—Service" have at times enabled it, under conditions of severe strain, to be one of the most valuable factors in the Armco organization.



First Advertising Literature put out by Armco

Chapter XVI

The Advertising of ARMCO

Early Advertising—Raw Product Advertising—National Advertising—Collateral Advertising—Armco Triangle—Development of New Products—Up-building of Morale.

WHEN the first national Armco advertisement appeared in the *Saturday Evening Post* in August 1914, it created considerable interest even among advertisers.

Here was a raw product being advertised to people who would never see it except in manufactured goods—something that would lose its identity immediately when it was fabricated. It was significant that Armco should be the pioneer in raw product national advertising. Since then this has become a recognized branch in the development of advertising. The story behind it is one of exceptional interest.

In the early part of 1907 when the merits of Armco Ingot Iron had been established through innumerable and severe service tests, the company first began to advertise the superior qualities of Ingot Iron in the trade papers and by direct mail matter to sheet metal distributors, mettallurgists, architects and contractors. The advertising gained for Armco some recognition in trade circles, but it was felt that Armco's story carried with it an interest reaching far beyond this limited field.

The qualities of "Armco" Ingot Iron rust-resistance, its welding and enameling properties, its electrical conductivity and its chemical purity destined it to play a part in the life of everyone—the manufacturer, the householder, the woman in the home. This realization of Armco's importance first suggested the possibility of advertising Armco Ingot Iron direct to the public.

An investigation was made in a number of cities, both large and small, among architects, metallurgists and manufacturers of sheet metal parts, stoves, refrigerators and of other products in which metal of this kind was coming into important use. As the result of this investigation,

it was decided that the merits of Armco Ingot Iron should be advertised direct to the public through national magazines. The name Armco, coined from the initials of the company, was taken with the addition of the words "resists rust" and made the advertising slogan. The national advertising campaign was launched with a two-page advertisement in the *Saturday Evening Post* of August 8, 1914. Many good advertising men of the day ridiculed the idea of nationally advertising a raw product and said that Armco was wasting its money. Time has made them reverse their verdict.

In order to get the best results from the national advertising, the salesmen were supplied with a portfolio of advertisements, instructed in the new advertising policy, and sent out to the trade backed by the force of the national advertising. At the same time Armco notified the trade of the new policy, sent them proofs of the advertisements, told them where they were appearing, and explained the object of the campaign. The result of this was to establish a more intimate contact for all concerned—the public, the manufacturer, and The American Rolling Mill Company.

The Armco national advertising was so successful in helping to mold a favorable public opinion that there quickly developed a widespread interest in the material and its uses, and a demand was created for articles made of Armco Ingot Iron.

Manufacturers of washing machines, refrigerators, stoves and other household utilities were quick to see the advantages to themselves and to their dealers of featuring in their national advertising that their products were "Made of Rust-Resisting Armco Ingot Iron." By using the Armco blue and gold transfers on their products and featuring its use in their catalogues and leaflets, in addition to magazine and newspapers, collateral advertising became a fact.

Thus, through the co-operation of leading manufacturers with The American Rolling Mill Company, the Armco national advertising is being complimented with a powerful collateral advertising campaign, which serves to intensify the work being done by Armco in a national way.

As a result of this intensive advertising a washing machine made of rust-resisting Armco Ingot Iron helps to sell a refrigerator made of the same material. A stove advertisement featuring Armco helps to sell a furnace made of the same material. This is true of galvanized iron pro-

ducts, of enameled goods and in other fields in which Armco superiority has been demonstrated.

Armco publicity reaches every nook and corner. For instance: If a man enters a modern hardware store today, he will probably be attracted by a fine electric washing machine display in the window. A second look will no doubt reveal the Armco triangle under the maker's label. He says to himself, "that is significant," for he realizes that the life of all metal washing machines lies in the rust-resistance of its metal parts. Stepping further down into the store he sees a garbage can with this same label; or he may see a galvanized pail or even a stove or furnace. Wherever the little Armco label appears it instantly links up with the national advertising, even though the particular article itself is not advertised.

A booklet "Who's Who in Armco" was published in 1919 containing a list of several hundred representative concerns in America who are using Armco Ingot Iron in the fabrication of their sheet metal products. The pages of this Armco booklet were made up of illustrations and descriptive matter of the various articles over the manufacturer's own name and address and include a broad variety of merchandise such as stoves, refrigerators, automobile radiator tanks, grain bins, ice cream cans, washing machines, wash tubs, garbage cans and a multitude of other items in which a rust-resisting iron proves an ultimate economy to the consumer.

In this way the Armco trade-mark "carries through" from the pages of the general magazine into the store and on to the home, where it meets itself in the pages in the general magazine again. The circuit is complete. All the time the public is learning to associate highest quality and long life with products made of Armco Ingot Iron.

There is another reason for the use of these Armco labels. Ingot Iron costs more than steel, yet has no outward distinguishing features to reveal its superiority to the eye or touch. While the housewife can easily tell the difference between cotton and wool and judge of its wearing quality by the feel of the cloth, she can safely rely on the little Armco triangle on which to depend in purchasing sheet metal products. It serves as a guide and gives full assurance of quality.

New markets for the use of "Armco" Ingot Iron open up almost every day. The publicity department makes it

a business to be prepared with proper information at any time to go into a new field, provided that field is one in which Armco products should properly take leadership.

Armco's national advertising campaign has not only aided the company from a sales standpoint but it has been of material assistance in building up and intensifying manufacturing morale. Armco men are eager to see that the work they do on the product in its various stages of manufacture results in the standards of quality that are guaranteed in Armco advertising. It has been responsible for the atmosphere around the works which has humanized the industry in the eyes of Armco men.

Armco believes in advertising—the small appropriation of a few thousand dollars a few years ago has grown to a very substantial sum. In order that Armco's advertising shall keep pace with the growth of the business, a fixed sum for each ton of output is automatically set aside for advertising purposes.

Since beginning its national campaign in 1914, Armco has been very consistent in advertising and has carried on the campaign whether oversold or not. In season and out of season Armco has continued to advertise the advantages of Pure Rust-Resisting Ingot Iron, because The American Rolling Mill Company believes that it pays to advertise and to keep on advertising.

Upon the firm that advertises is thrown the responsibility of maintaining quality products. Especially is this true when, as in the case of Armco, other firms through collateral advertising are spending large sums designating that their products are made of Armco Ingot Iron. The Armco organization has gladly accepted this responsibility for the manufacture of high-quality products, which has been placed upon it by extensive national and collateral advertising.

Chapter XVII

Sketches at ARMCO

Pen and Ink Sketches Drawn in the ARMCO Plant by Raymond Perry of New York City, for The American Rolling Mill Co.

WHEN Raymond Perry, the distinguished artist who painted the picture "Armco Spirit" shown in the frontispiece, was in Middletown he executed ten pen and ink sketches of important operations in The American Rolling Mill which are reproduced on the following pages.

It was something unusual for an industrial organization such as Armco to show its appreciation of the artistic side of its everyday operations. Futhermore many artists of the standing of Mr. Perry would not have cared to don overalls and carry his paint and brush into the disquieting noise, heat and inconvenience of a steel plant.

Mr. Perry was enthusiastic over his opportunity to meet the men at their daily task. The workman too were very much interested in watching the picture grow under his deft touches. "Every man to his trade" said one big fellow pausing to wipe off the sweat preparatory to swinging a hot iron bar into the rolls.

Mr. Perry, of New York City, is a member of the Salmagundi Club, one of the oldest and best known artist's clubs in the country. During the Great War he was associated with the division of pictorial publicity and furnished posters and other illustrations for the Liberty Loan, Salvation Army, and other activities.

According to his own statement, Mr. Perry prefers as subjects for painting, industrial themes such as are exemplified in his painting "Armco Spirit" and in the drawings which follow. The vigor of Mr. Perry's art and his mastery of line and detail especially fit him for this work of portraying the vital operations of what iron and steel workers have long called a "he-man's industry."

Sketch of Blast Furnace

THE blast furnaces run day and night smelting the red ore into pig iron—about six hundred tons of pig iron every day. Iron ore, coke, and limestone are charged into the top of the blast furnace in which they are reduced to a molten mass under a powerful heated draft. The molten iron collects in the bottom of the hearth where it is tapped from the furnace about every four hours. This is the scene artist Perry caught as he dodged the sparks.

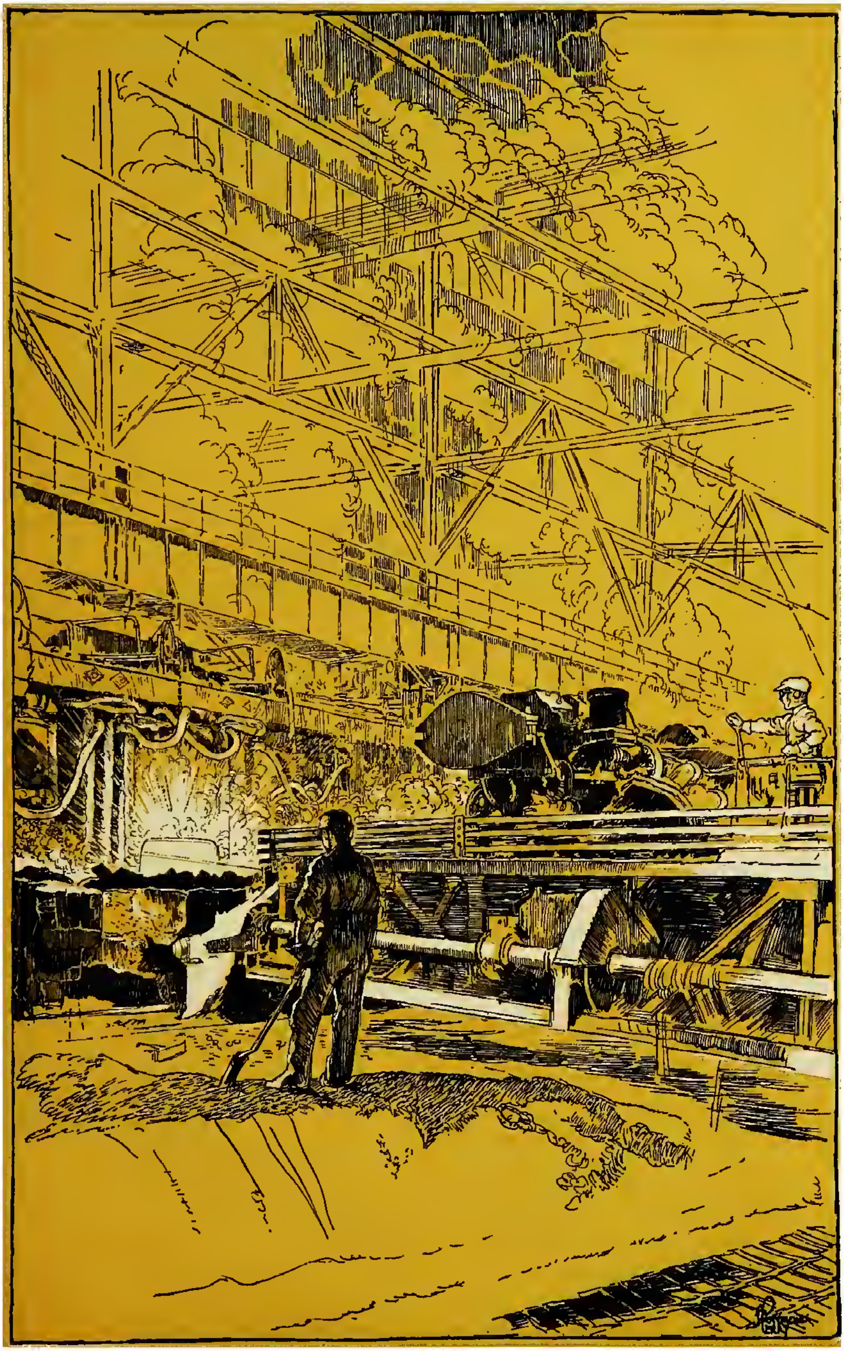
Sketch of the "Skull Cracker"

THE "skull cracker" is well named. In pouring heats, a part of the iron cools rapidly around the inside of the ladle, and, when removed, this shell is termed a "skull." It is several feet in diameter and must be broken into pieces before it can be put back into the furnace.

The "skull cracker" consists of an electric magnet operated by an overhead crane, which draws a huge iron ball up to the height of sixty feet. This ball is centered upon the skull, the current is released, and the ball falls. "Safety first" demands that every one hide behind some thing to avoid flying pieces of metal when the ball drops.

Sketch of Open Hearth

TO gaze into the seething lake of boiling metal in an open hearth furnace brings a suggestion of the Inferno as the flames above the surging white iron flare from the furnace door. When charging is going on the furnace doors are opened by machinery. The charging machine picks up the huge pan of material, pushes it into the furnace, dumps it, brings it out, puts it in place, and then moves on to another with an action that is almost human.



Sketch of Teeming a Heat

FROM ninety to a hundred tons of molten metal is swung through the air as the crane lifts the ladle after the last of the heat has been tapped from the furnace, and carries it to the ingot train where the metal is "teemed" into ingot molds. A valve in the bottom of the ladle is opened by means of a stopper rod and the metal is allowed to pour into the mold. The stream is then cut off just long enough for the ladle to be moved into position above the next mold. Occasionally the valve refuses to close and the ladle must be moved from mold to mold without shutting off the stream of molten metal. At such time a great deal of metal is lost, though a beautiful display of fireworks results as the metal strikes on the edge of the molds and sends sparks showering in all directions.


RAYMOND PERRY

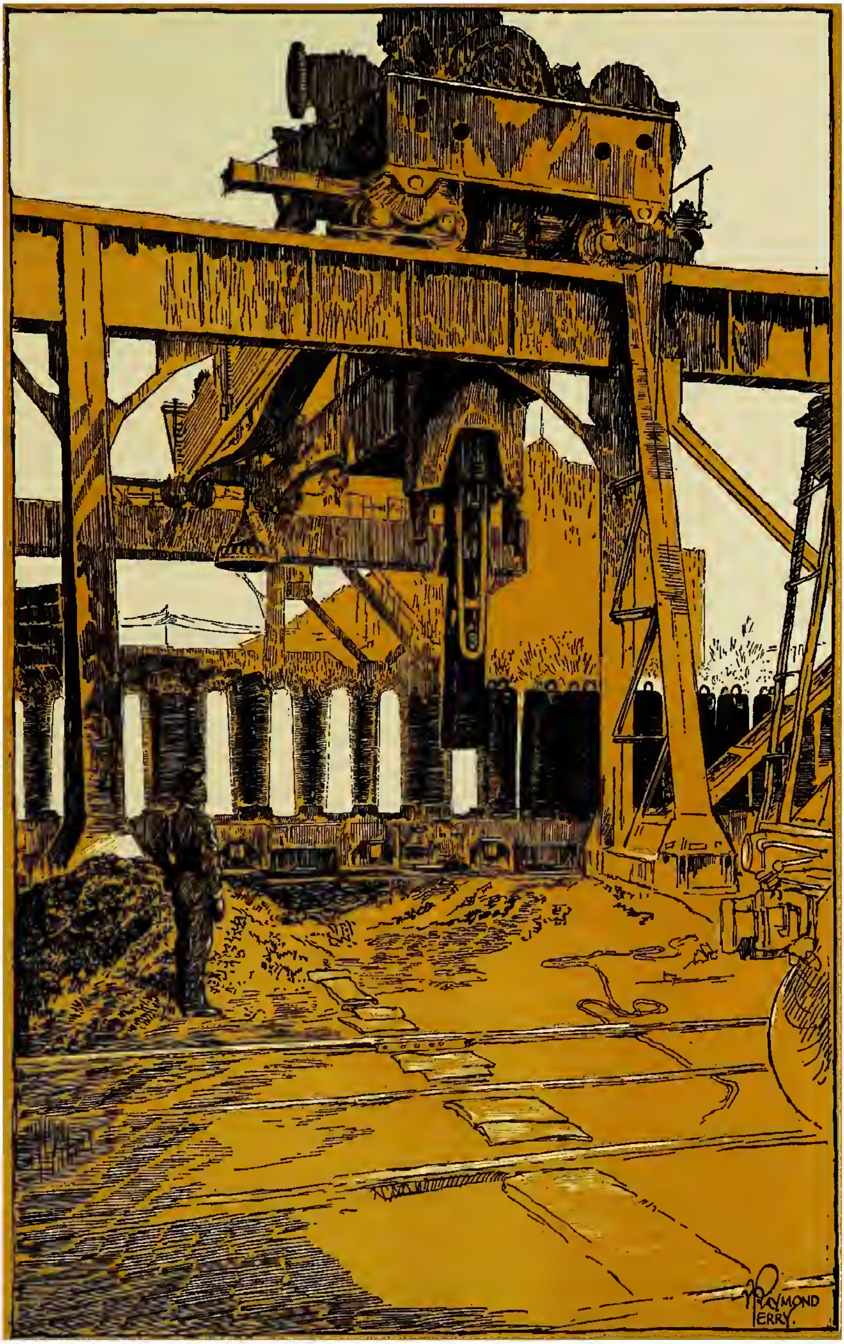
Sketch of Relining a Ladle

THE great one-hundred-ton ladle into which the molten iron or steel is tapped from the furnace must be relined from time to time. Magnesite brick is used because it offers greater resistance to heat than ordinary brick. When the lining has been completed a gas flame is burned in the ladle for several hours to thoroughly dry it out. On rare instances when a newly lined ladle has not been thoroughly dried before tapping, the steam generated upon the in-rush of the liquid metal has caused severe explosions, at times even bursting the ladle.

Sketch of Stripping the Ingots

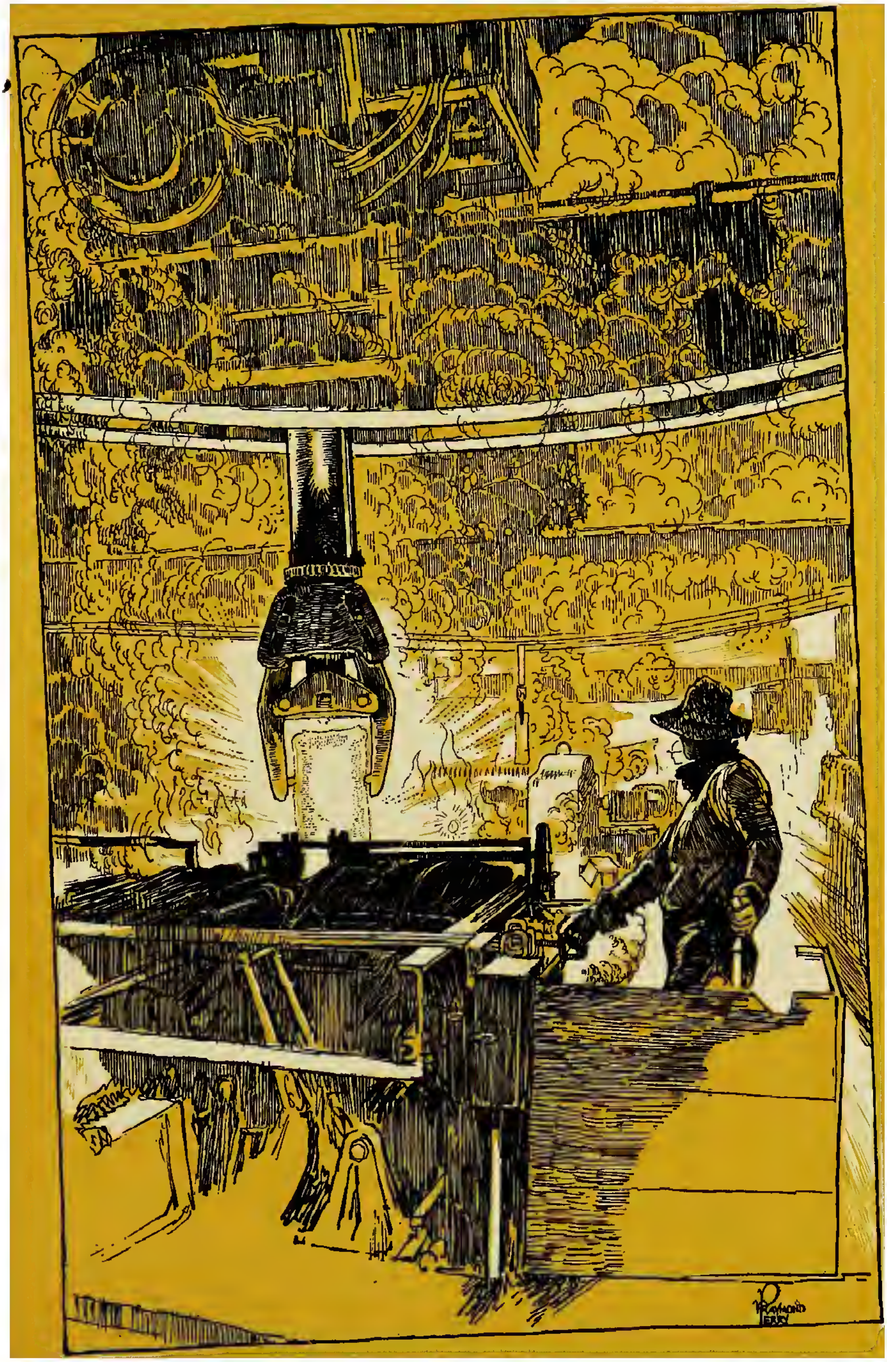
TO remove the ingots from the molds the stripper crane reaches down, fastens its claws over the lugs protruding from the top of the molds, and lifts them clear of the ingots. Occasionally an ingot sticks to the mold and then a powerful plunger strikes the ingot irresistibly forcing it out of the mold.

Before the installation of the stripper crane with its powerful plunger, it was sometimes necessary to swing a "sticker ingot" up to the roof of the building and then let it fall in order to knock the ingot from the mold.



Sketch of the "Soaking Pit"

IN spite of its suggestive name the "soaking pit" does not contain water but ingots at a white heat. When the molds have been stripped from them the ingots are solid on the outside but still molten within. Before they can be rolled they must be allowed to solidify in the center and be brought to a uniform heat throughout. At Armco twenty-four of these pits are in use where the ingots are brought into a condition for rolling. For several hours the ingots are soaked in this intense heat and are then taken out and carried by a pit crane to the blooming mill.



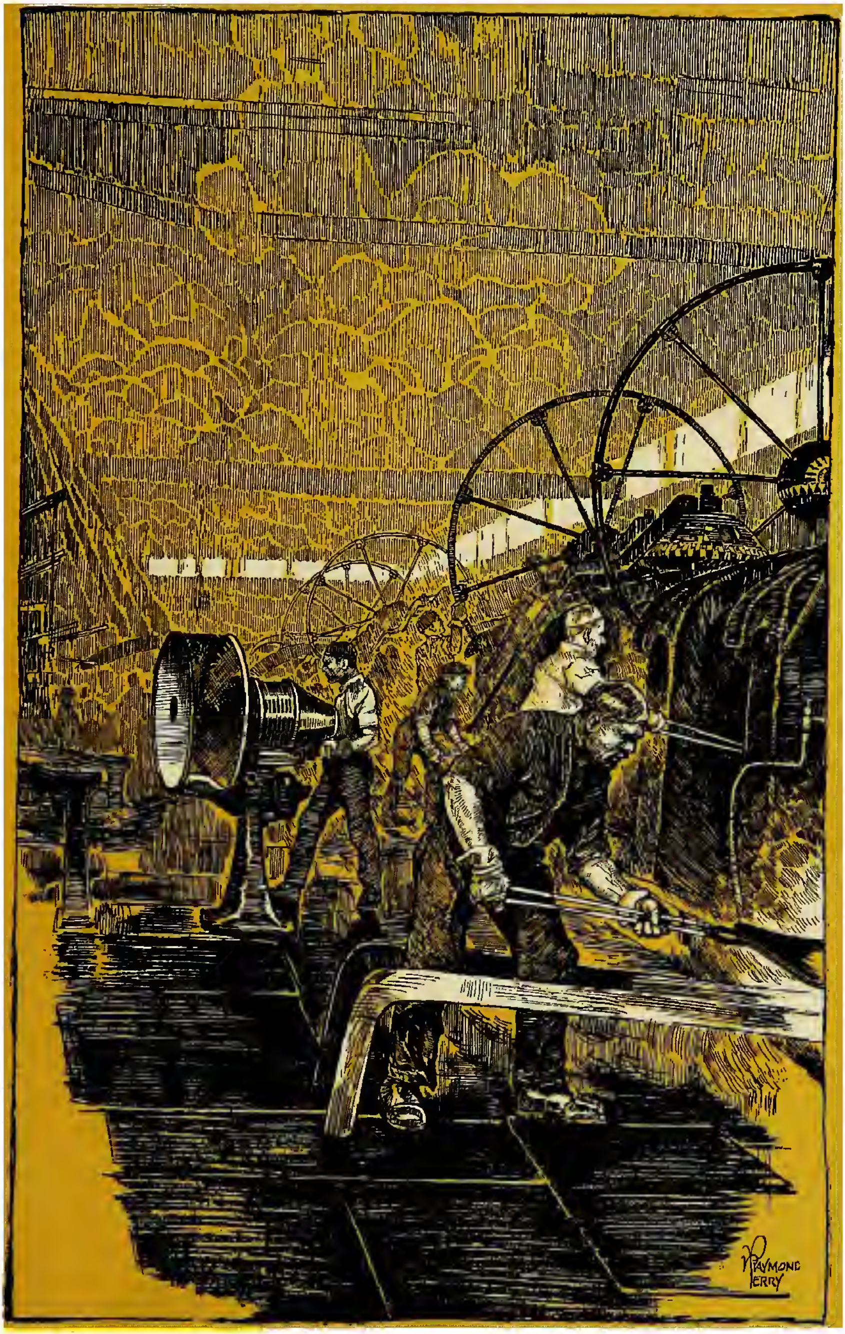
Sketch of the Blooming Mill

THE reduction of ingots into blooms, billets and slabs is a most interesting sight. The soaking pit crane delivers the white hot ingot to an electrically controlled roller conveyor leading to the blooming mill which operates on the principle of a gigantic clothes wringer. As the ingot reaches the rolling table two large hydraulically controlled guides, one on each side, move towards the ingot and guide it to the proper entry into the rolls. The first pass through the rolls generally ends in a loud report similar to the boom of a cannon and the throwing of sparks in all directions. At intervals during the rolling, long hydraulically controlled fingers reach up through the rolling tables and turn the hot ingots over and place them in the position desired by the operator in the "pulpit."


RAYMOND
PERRY

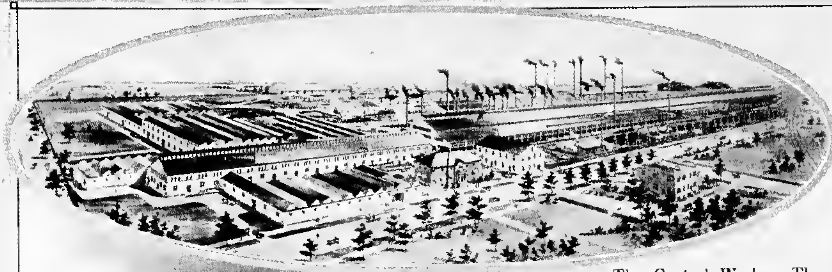
Sketch of the Sheet Mill

IN the sheet mill men of mighty muscle stand heaving the red hot bars back and forth between the rolls. The sheet bars, thoroughly heated, come in pairs from the furnace and are given a few passes on the "roughing mill." Then they are passed back and forth between the finishing rolls until they are reduced to the required gage. In case of light gages the sheets, doubled in packs of two, four, eight, are reheated before the rolling is continued. The work of the sheet mill requires skill and endurance in a very high degree, and, from the human side, is the most picturesque in the mill.

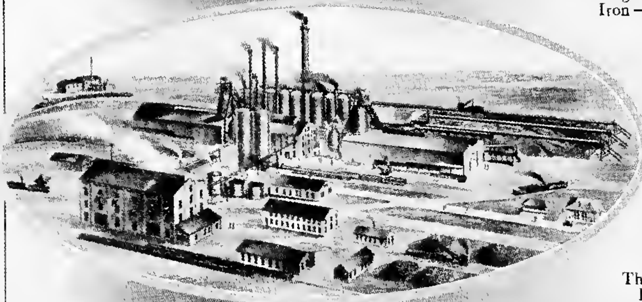

RAYMOND
PERRY

Sketch of a Galvanizing Pot

SHEETS for galvanizing, after being pickled and washed, are first run through the flux box and then the galvanizing pot where they take on a coat of pure spelter which protects them from the elements. As they leave the pots the sheets are passed through exit rolls which regulate the weight of the coating. Because of its purity, Armco Ingot Iron does not dissolve so rapidly in the molten zinc as does steel, and thus Ingot Iron is permitted to take on a purer, more durable coating.

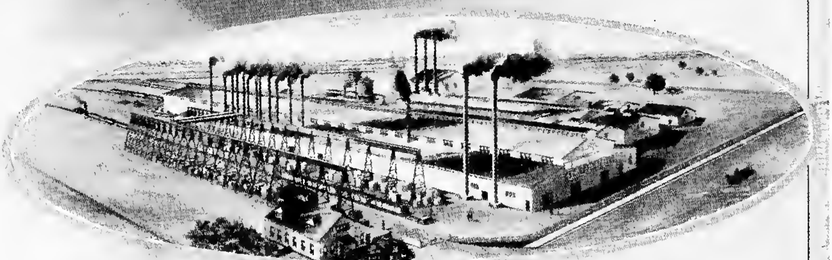


The Central Works — The Original Home of Armco Iron — Middletown, Ohio

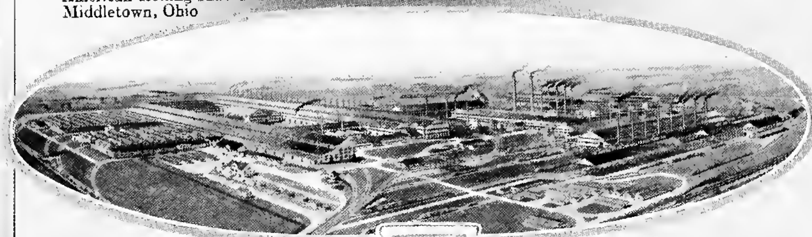


The Columbus, Ohio, Blast Furnaces of The American Rolling Mill Co.

The Zanesville, Ohio, Plant of The American Rolling Mill Co.



The New East Works of The American Rolling Mill Co. Middletown, Ohio



Chapter XVIII

Employment at ARMCO

Growth of the Personnel—A Centralized Employment Bureau Built—Expansion and Organization as a Department—Hiring Practice—Follow Up—Promotion—Contact with Foremen.

WHILE ARMCO has been growing in plant and in capitalization, it has also been growing in men. At the end of the first year there were four hundred and fifteen men employed by the company: in the peak month of 1920 fifty-seven hundred and twenty-five persons were required to bring the organization to its maximum production.

The first five years was a period when the personnel labored under great handicaps of equipment, a period when labor was plentiful and cheap, and was ordinarily used in preference to machinery. At the close of the fiscal year ending June 30, 1905, six hundred sixty-eight men and five women were on the payroll of the company, including those employed in the Zanesville plant which had just been purchased.

At the end of the next five-year period the East Side Works was under construction and The American Rolling Mill Company had been forced to take over the construction. Although actual operation had not been greatly increased since 1905, on account of this construction work the employees of the company on June 30, 1910, numbered fifteen hundred and sixteen, of whom fifteen were women.

In 1915 the peak of the pre-war growth was reached as the East Side Works was put in full normal operation. At that time the working force contained twenty-seven hundred and forty-nine persons of whom forty were women.

The next five years was not a period of normal growth but was marked by violent increase and decreases in the personnel in response to war conditions. In November of 1918 the peak of war activity was reached when fifty-six hundred thirty-eight persons were manufacturing munitions. The close of the World War brought a sudden

slackening in industry and in six months the working force had been reduced to forty-two hundred. The American Rolling Mill Company, through its employment department, put every person in touch with a good job whom it was compelled to lay off. In 1919 and 1920 there was a great boom in the sheet metal industry and the number employed rose to a peak equal to that attained during the war, the highest point being reached in November of 1920, with the employment of fifty-seven hundred and twenty-five persons, of whom one hundred and ninety-four were women.

The working force of this last five year period was, on the whole, of a very different character from the one with which the business had been run during the first five years of its existence. The character of the business had changed. Refinements in practice had been introduced. In general the company acted on the principle that whatever could be done by a machine should not be done by a man, yet it had never made this change at a financial loss. A three-shift basis had been introduced instead of a twelve-hour day wherever the change was productive of greater efficiency. The quality of the force had been developed as had the quality of product. During 1919 and 1920 through the coal strike, the steel strike, and the excessive heat of the summer of 1919 when many other steel mills were forced to shut down, Armco was not closed for one day.

Entrance to Employment Department

The handling of an increasing personnel demanded new administrative departments, departments which would represent the management to the men of the plant. These departments are the five in the personal service division which have had a gradual evolution accompanying the growth of the business.

One phase of the personnel work lies in the hiring and placing of new employees, in supervising payment and promotion. The methods of doing these things have developed with the plant. For some years after the company was organized, if a foreman was short of hands he went to the gate, looked over the crowd, picked out the man he wanted, and hired him. Both the hiring and the making of promotions were under the direct charge of the foreman and department heads.

Not until 1911 when the East Side Works was built was the centralized employment bureau organized. At that time the employment office was distinctly a bureau and not a department. It reported directly to the general superintendent until 1913 when it was placed under the supervision of the head of the safety and labor department. Until 1914 it hired for the East Side Works only, but at that time it extended its service to the Central Works operating department also.

In 1916 the bureau's functions had so expanded that the employment department came into being, reporting to the Vice President in charge of the operating division. In 1917 this new department was extended with the purchase of group insurance, giving service to the Zanesville plant. Similar service was extended to the blast furnace division, after the consolidation with the Columbus Iron & Steel Company. In 1918 a further extension of service was made to the general office since the employment department then reported to the head of the personal service division.

In the days when each foreman hired his own men at the gate the routine was something like this.

FOREMAN—"Hey, you!"

Four or five men start forward but the one wanted is finally picked out.

FOREMAN—"You want work?"

MAN—"Sure."

FOREMAN—"Billy, give this guy a check, and I'll tell you his rate after I try him out."

But since the organization of an employment department, every care is taken to make a man feel at home when he enters the waiting room to apply for a job. On entering the room the applicant is directed to a seat where reading material is kept in a rack nearby in case the number of men ahead of him should necessitate his waiting. In front of him the applicant reads the department's motto, "Happy men on Happy Jobs." Each man is given a private, personal interview. The interviewer's name is hung in the window of the partition, which separates his desk from the waiting room, so that the applicant may know with whom he is talking. The interviewer greets the man in a friendly way and gives him a chair, not across the desk, but at one side of it, thus putting the man much closer to the interviewer and removing the barrier between them. If, in the judgment of the interviewer, the company has need of such a man as the applicant, he is turned over to the write-up man who records certain data in regard to the man's previous experiences. The information thus gathered is held in strict confidence.

In case the man is not needed at the time, he is told so as considerately as possible. In case the interviewer thinks there may later be an opening for him, the man's application is placed on file. This procedure is not a mere routine method of dismissing a man; it actually serves to bring the man up for later consideration.

In general men are hired only for the minor positions, for it is the policy of the company to fill its important positions with men who have had their training in the Armco organization. This method not only gives Armco men greater opportunities for promotion but it serves to limit the largest part of the labor turnover to jobs where the turnover is relatively inexpensive.

If accepted by the interviewer the prospective employee is sent to the medical department for physical examination. The physical examination is designed to reveal defects which would prevent a man from filling the job for which he has been hired, and it is a part of the Armco program of fitting men to the jobs. Armco does not hire the muscle; it hires the man. The physical examination is not made until after the man has been hired.

With the medical certificate in hand the new employee returns to the employment office where he is given an employment certificate. Then he is taken to the clock

house, given his check and shown how to punch his card. An employment man then conducts him to his foreman, over the proper route, and personally presents him to the man under whose direction he is to work. At one time this introducing was done by messenger boys or superannuated employees. But during the war the department decided that it was necessary to get the man on the job in the right frame of mind; so the introduction to the foreman and to the work was placed in charge of carefully selected and trained young men who possessed a thorough knowledge of the company's business and policies and the knack of gaining confidence.

The department has never maintained an elaborate follow-up system but at the end of three days the new employee is interviewed to see that he is properly placed. In dealing with the foremen the department emphasizes the importance of encouraging men, of giving judicious praise for work well done.

Not until the foreman has accepted the man, rated, and signed his employment certificate and sent it on for approval is the man actually hired. Even then the department or division head may reconsider the foreman's judgment. The company believes that the hiring and placing of men is primarily the responsibility of the foremen and superintendents.

During the war and post-war period the employment department was largely expanded to care for the increased personnel. Three interviewers met the applicants and in addition to this duty were charged with keeping active personal contact with the men in a certain section of the plant. Every day these men covered their section and in the evening they met for what was nominally a fifteen minute meeting—though it often lasted for an hour—to talk over the questions encountered in their sections.

In 1917 an insurance system was instituted whereby after the employee has been in the service of the company for one year, his life is insured for as much as the total of his year's wages, not exceeding $1200. The man himself names the person to whom the insurance shall be paid.

Promotions at Armco are never decided by referring to a card index. The Armco organization is built on men, not plans. The system of the employment department has been so devised that before any decision affecting a man can be made, it is necessary to see and talk

to that man personally. Once a year, to make sure that each man comes up for consideration at least that often, every man is rated by the foreman with the aid of a representative of the employment department. As far as possible every position is filled by promotion rather than from the outside. Especial care is taken to make the promotions just, to see that the men who are most efficient receive the coveted advances rather than the men who know best how to pull for themselves.

The department makes every effort to keep in close touch with the foreman. In the summer of 1921 a foremen's library was opened in the employment office which served a real need and had immediate popularity. The practice of the employment department is fully explained to the foremen and their fullest cooperation in handling the personnel is continually sought.

Throughout its entire operation the employment department is animated by a desire to render service to every man, and in all its dealings to treat the employee and the applicant with all possible courtesy. Its personnel is selected with this purpose in view and every detail of its operations is planned to subordinate systems and plans and to bring men into the center of decision and action.

Chapter XIX

The Growth of ARMCO Medical Service

Building of Shop Dispensaries—Main Hospital—Colored Club Hospital—Broadening of Medical Service—Physical Examination—Accident Service—Cooperation with Other Departments.

DURING the period of construction of the East Side Works, and with its completion in 1911, the officials of the company felt the need of better facilities for taking care of injured employees, the need of a department definitely organized to carry on this important phase of industrial work. They felt that the company's duty to Armco men did not begin and end with accidents, but that the company should do everything within reason, that was sound and in accord with good business, to help employees to become better citizens, thrifty, and happier workmen.

The first step toward the organization of such a department was the engaging of a surgeon to care for accident cases and to study the company's medical needs. To carry on this work two small dispensaries were established. One dispensary was located in the rooms now occupied by the photographic department at Central Works, and the other was operated in connection with the time office at the main entrance of the East Side Works.

These two small dispensaries formed the nucleus from which has sprung the Armco main hospital, colored club hospital, Central Works dispensary, shops dispensary, treatment room in the Administration Building, and physical examination department. Ambulance stations with motor ambulance service have replaced hand conveyed stretchers. From the sole care of accident cases, the work has been amplified to include the treatment of employees for injuries or ailments beyond those coming under the provisions of the state compensation law. So long as a man is able to work and be on the job he is entitled to this medical service, which is given free of cost to the employees.

A Modern Hospital Safeguards the Lives of Armo Men and Women

Armco Hospital Building

The main hospital, which was built in 1911, is complete in every way. It contains waiting, dressing, sterilizing, drug dispensing rooms; and office, kitchen, dining, and living rooms for the matron; a fully equipped operating room and wards for patients. A complete laboratory is provided where analysis of all kinds both microscopical and chemical can be made, and one of the latest Kelley-Koett transformer type X-Ray machines is in use.

The colored club hospital, which was opened in 1918, is maintained in connection with the Armco colored club and consists of waiting, dressing, and drug rooms; a kitchen, pantry, bath, two private rooms and two ten-bed wards. The hospital is maintained for the care of colored men who live in the camp. Not only are accident cases among colored employees promptly taken care of at this hospital, but if men living in the camp become sick, they are taken care of and are given the best possible medical and nursing attention.

The Central Works dispensary consists of three rooms, waiting, dressing, and consultation. It is maintained for the convenience and care of men who may become sick or are injured while at work in the Central Works plant.

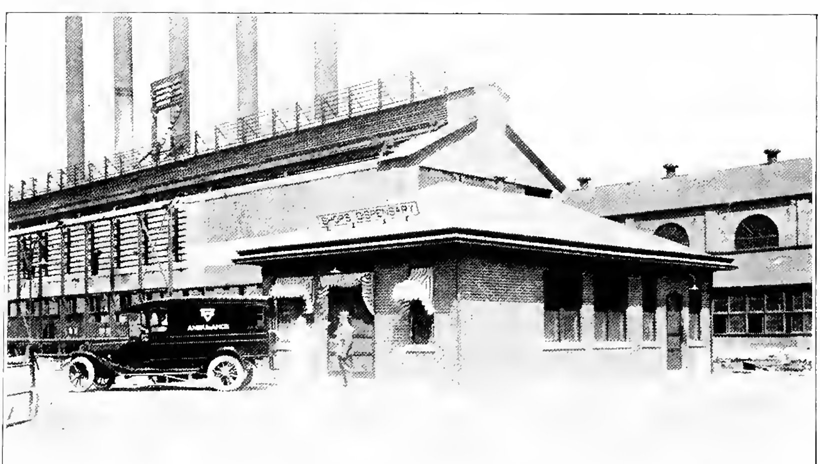
The shops dispensary at the East Side Works was built and equipped during the winter and spring of 1918 and was opened in close proximity to the forging, and subsidiary departments, in order to take care of injuries occurring in these departments, and to save the long journey

to the main hospital. Here at this new shops dispensary, it takes injured and sick men only about one-fourth as long to have their wounds dressed and ills cared for as it did when they were required to walk about a half mile to the main hospital. This dispensary is a complete little hospital in itself, with waiting, dressing, drug, and special treatment rooms, and a rest room for girls working in departments nearby.

A waiting and treatment room for the convenience and treatment of office employees has been maintained in the general administration building since its erection in 1918.

Each of these dispensaries and hospitals are fully equipped for the work intended. For instance, the treatment room in the general administrative building is equipped with a modern nose and throat outfit and electric cabinet for giving Foradic, high frequency, and violet ray treatments, a Burdock light cabinet and other appliances to take care of ailments common to office employees.

The personnel of the medical department normally consists of three full time physicians, six graduate female nurses and five experienced male nurses, three clerks, a matron and two janitors. The watchword of the department from the beginning has been "Service to all alike regardless of race, color, nationality or position." The doctors and nurses have striven to know men only as men, and not by their position. "A square deal for all



Shops Dispensary at East Side

with special favors to none," has become the departmental slogan.

The scope of the work done by the department has gradually widened. In the beginning no attempt was made to treat the minor ailments of employees of the company, even though they were on duty. The work was confined entirely to the care of accidents that occurred in the plant. Today the medical department not only administers to a man's needs when he is injured in the plant but he may feel free to come to any one of the various dispensaries for any injury or ailment, either real or imaginary, so long as he is on the job. When an employee's condition becomes such that it is not advisable for him to work, or he thinks he is not able to work, he is laid off and advised to consult his family physician, as Armco makes no attempt to treat men who are laying off and not able to work. Neither is it the policy of the company to treat the members of any Armco men's families.

The physicians and nurses try to keep in close touch with the kind of work the men are doing in the shops, not only that they may better understand how this, that, or the other accident happened, but that they may know the men themselves. This personal acquaintance gives each a better understanding of the other and greatly facilitates the work which is of mutual interest to the company and the injured employee.

The physical examination department is primarily a safe-guard to the health of the employees. Every applicant for employment is given a careful physical examination. This is of great assistance to the employment department in placing a man in the position for which he is best suited physically and mentally. Subsequent examination and treatment are given to men whose health requires it and not infrequently defects and incipient disease conditions are detected, which can be corrected before they become serious and without the loss of time to the patient. These consist principally of diseases of the heart, kidneys, lungs and similar afflictions.

A careful record is kept of all the work done by the department. In the case of accidents, the nurse or physician who attends the injured employee takes a complete history of the case, giving the man's name, check number, nationality, residence, whether married or single, time of service for company, experience at kind of work he was

doing when injured, time, location and how accident happened, nature and extent of injury, whether or not injury has been neglected, etc. In the case of a more serious injury the safety engineer is notified at once. He immediately investigates to determine whether or not the accident is due to any existing conditions in the mill. If so, he gets busy. But if the evidence given in the history of the case indicates that the accident might have been the result of a defect of hearing, sight or some other physical or mental defect, steps are taken at once to correct this. If this can not be done, the company physician usually recommends a transfer to some such work where the injured employee will not be as liable to injury or to injure some one else.

In case a man is laid off on account of either accident or sickness his brass check or breast pin is taken up by the physician or nurse who attends him and he is given a receipt for it. The check is sent to the clock house with the laid-off slip and the timekeeper lifts his time card and replaces it with a red card. When the employee is able to resume work he goes to the clock house and gets his red card, takes it to the hospital, has it O. K'd. for him to return to work, and his brass check is then returned to him. This is done as a precaution against a possible relapse or injury due to weakness.

If it is noted from his clinical record than an employee is a frequent sufferer from headaches, dizziness, cough, constipation or other ailment, he is not infrequently asked to report either at the physical examination department or hospital for a careful examination to determine the cause of the trouble. If in the opinion of the company physician a sputum, blood, urine or X-Ray examination is necessary to determine the cause, it is made free of charge. Since no man can do his best when he is sick, the company feels that it is only "good business" to keep the men well and on the job, as they make steadier and more efficient workmen. The company realizes that it is safeguarding its own best interests when it safeguards the health of its employees.

Through the physical examination department, the hospital and various dispensaries, the medical department uncovers many incipient cases of heart, lung, liver, teeth, stomach, kidney and bladder troubles—troubles that afflicted employees often little suspect.

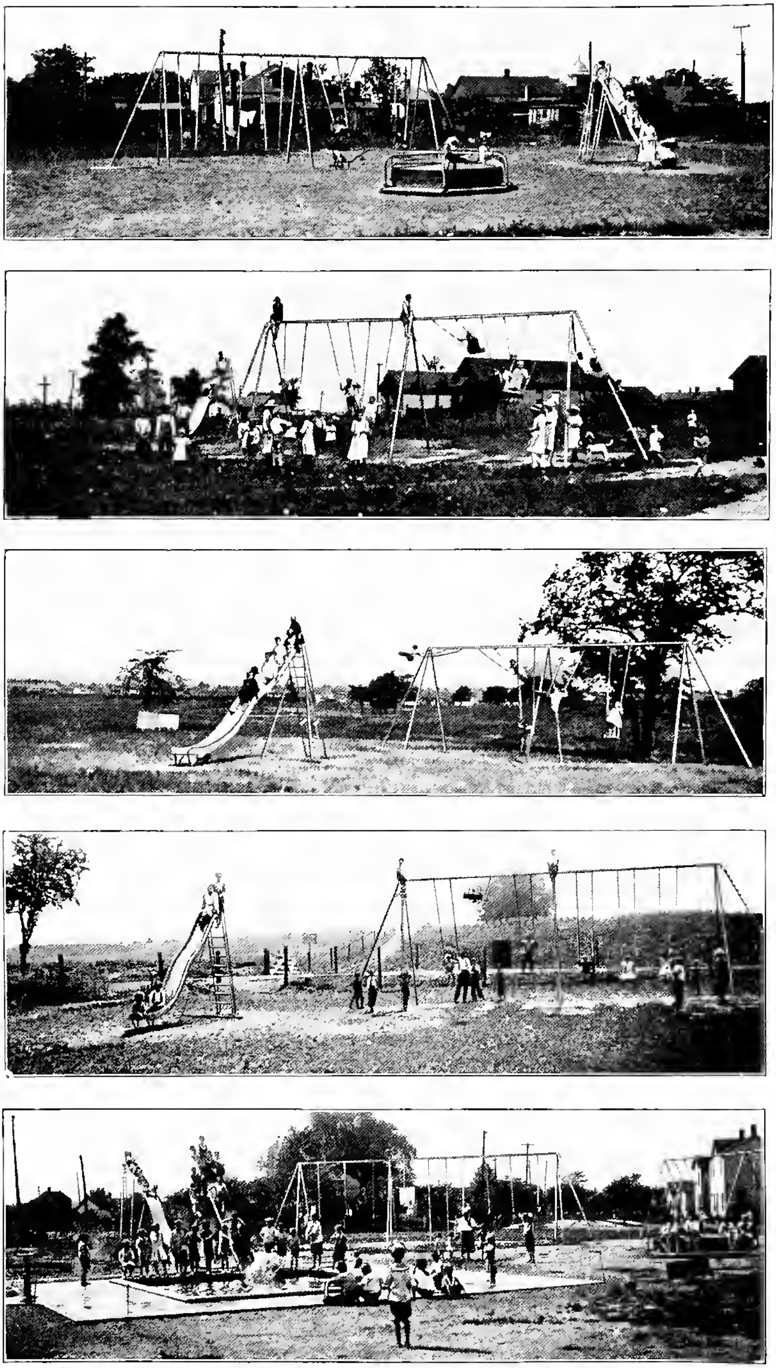
Eight years ago it was not uncommon to have four or five bad cases of heat cramps a day, cases that not only required the services of the doctors and nurses, but the services of their fellow workmen to assist in massaging their cramping muscles. For the past four or five years such severe heat cramps have been nearly unknown. In the spring and summer, a few cases of heat exhaustion still occur, but not such cases as used to be common. The medical department feels it has played no little part in eliminating the cause of these, as well as many other conditions which are injurious to the health of employees.

A chemical and bacteriological examination of the drinking water supply is made at regular intervals to insure a wholesome quality of water at all times in the shops.

The medical department, in addition to the care of injured and sick employees, has worked hand in hand with the safety and sanitation department in their untiring efforts to safeguard all dangerous machinery and to improve the working conditions in the shops. The physicians from time to time not only go on inspection trips through the shops, for the purpose of becoming better acquainted with the men and their work, but to detect conditions which might be injurious to the health of the men.

Systematic educational talks are also given to various groups of employees in the shops along the line of safety and preventive medicine. It is believed that it is better to prevent an accident than to take care of it after it has occurred, and for the same reason, it is far better to remove the cause of sickness and disease, thus preventing employees from becoming sick, than to treat them after they are ill. There is no more important and necessary work in the field of industrial medicine and surgery than guarding the life and health of the workers.

Industrial medicine and surgery is one of the greatest specialties in the realm of medicine, for it not only anticipates the care of a man when he becomes sick or injured, but it includes the whole field of preventive medicine and the eradication of the cause of disease. Armco believes it means better, healthier and happier citizenship.



Armco Playgrounds

Chapter XX

Personal Service work

Safety Committees—Safety Department Organized—Accomplishments of Safety Department—Mutual Interest Department Organized—Housing—Gardens—Home Improvement—Absentee Vistor and Nurses—Colored Visitor—Colored Club and Secretary—Playgrounds—Parks—Grocery—Restaurants and Clubs—ARMCO Bulletin.

THE American Rolling Mill Company believes that men can give their most efficient effort only when they come from good homes to work in clean, well ventilated and safe mills. In consequence it makes every possible effort to promote the health, happiness, and prosperity of its men. The part Armco has contributed toward the improvement of working and living conditions of its employees has not been a philanthropic enterprise but an undertaking which has grown out of the common interests of the company and the men; and therefore this activity has been very appropriately named "Mutual Interest Work" rather than "Welfare" work, which savors of paternalism.

Long before there was any "Mutual Interest" work at Armco, the company realized its responsibility to the men in the prevention of accidents, and proceeded to institute safety plans throughout the plant. Once each month at the weekly meeting of all the superintendents the subject of "safety" had preference over all other matters. From these meetings the various superintendents carried back with them to their departments ideas of safety first.

Need was soon felt for an organization to direct this important work, and the central safety committee, consisting of three members, was appointed in 1910. This committee met at stated intervals and made recommendations covering policies relating to safety and the installation of safety equipment.

As an aid to the central safety committee another committee was appointed to co-operate in the work it was doing. This committee was termed the Works Safety Committee, and was composed of three members appointed to serve for a period of two months. During

this time they made a complete inspection of the plant and reported their findings to the central safety committee. The central safety committee was afterwards enlarged to include the heads of nearly all the main departments of the operating division and now meets once a month to consider safety problems and make recommendations.

In 1913 Armco had a part in the organization of the national safety council which was a development of the Iron and Steel Plant Electrical Engineers Institute.

The office of director of safety and labor was created in 1915 in which office, in addition to other duties, was centralized the control of the safety and mutual interest work.

In the next year a safety engineer was secured, and early in 1917 the safety department as such was organized. Since its creation it has reported to the director of safety and labor, and has had its headquarters in the employment building near the entrance to the East Side Works.

Following the appointment of the safety engineer, the scope of safety work was gradually broadened and a safety committee was appointed in each department. These committees, because of the intimate relation of their members to the points of danger and their familiarity with operations and practices in their departments, have become the greatest factor for safety in the whole organization.

One phase of the work of the safety department lies in the installation of proper safeguards on machinery. The full support of the management has been given the department in this work with the result that so well are all machines guarded that there were no accidents from this cause in 1920, the fourth full year of operation of the department.

The other phase of its work lies in educating the working force, in creating in them a "Safety First" attitude. To this end safety articles and notices are published in the bulletins, safety signs are posted about the plant, and most effective of all, the foremen give a great deal of time to impressing upon their men the necessity and wisdom of doing the job safely.

Since the installation of the safety department the number of accidents and the number of days lost because of accidents have steadily decreased. In 1911 the number

Children's Play House

of lost time accidents per hundred men was sixteen and forty-six hundredths; in 1920 it was only two and seventy-six hundredths. In 1917 there were one hundred and ninety-one days lost per hundred men on account of accidents; in 1920 there were only thirty-three and four-tenths days lost per hundred men from this cause.

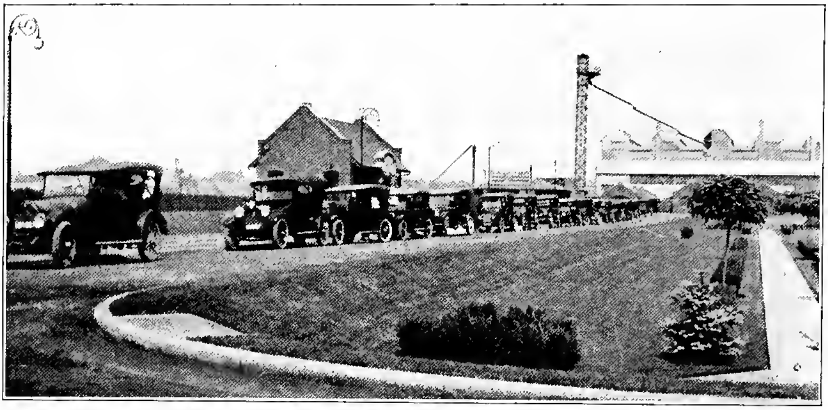
In addition to its successful work at the Middletown plant, the safety department during the first four years of its existence organized safety committees at Columbus, Zanesville, and the Marting Mine, all of which have been very effectual in reducing accidents in their respective plants.

In the same year that the safety department was organized, the mutual interest department was taken from the immediate supervision of the director of safety and labor and put under a separate head who reports to the director of safety and labor. The company believes that a man whose personal and domestic affairs are pleasant is a more efficient workman. It therefore maintains a corps of workers to help adjust or relieve conditions which might cause a man to lose time or hinder him from rendering his best service. Its activities are varied and touch many phases of Armco home life.

Housing service is one of these. From time to time the company has acquired houses which it rents, principally

to the foreign born. It also renders what aid it can in finding houses for prospective renters.

Ever since 1914 the company has prepared, and provided garden plots to employees who applied for them. These gardens average an eighth of an acre each and are plowed and harrowed free of charge. In the last year of the World War eight hundred and fifty-nine gardens were given out and the produce from them amounted to more than $30,000.00.

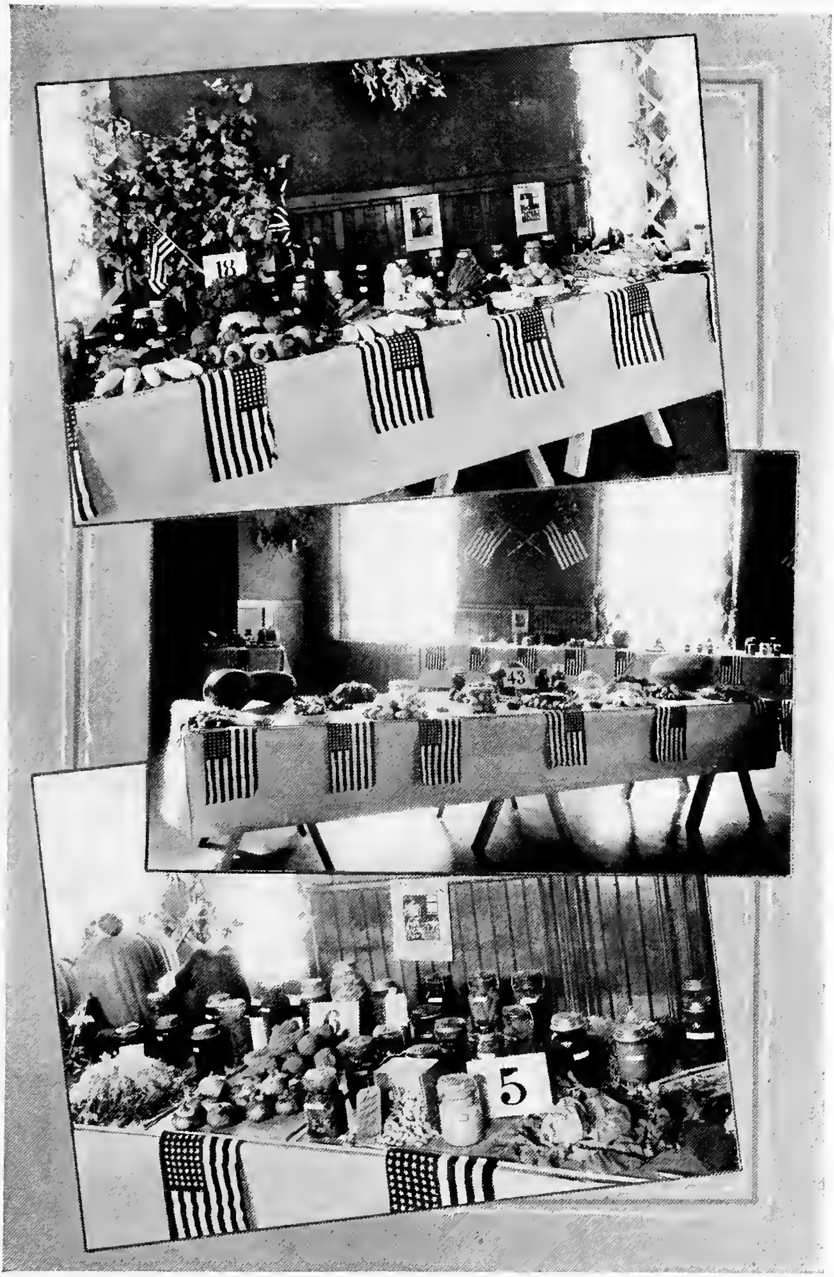


Armco Bank on Pay Day

The mutual interest department is also interested in the appearance of the homes of employees. To stimulate the appearance of homes among Armco employees the company for some time offered two annual prizes each for the best vegetable and flower gardens. Monthly prizes were also offered to the foreign born workers for the best kept houses and yards.

In 1917 an absentee visitor was employed whose duty it is to call at the homes of men who have been absent from work and ascertain the cause. Often this service makes it possible for the two visiting nurses employed by the mutual interest department to render aid, either in caring for the man if he is sick or for his family if these conditions kept him from work. This service has enabled many a man to go to work with the assurance that his family was being well taken care of.

In addition to the absentee visitor and the two visiting nurses who visit colored and white families alike a young colored woman was employed to visit the colored families, not as a nurse, but in the capacity of a friend. This



Armco Garden Exhibit 1918

colored visitor has organized sewing clubs, and a literary club. In the winter she teaches a large kindergarten class and in the summer supervises playground activities in the colored subdivision, which were maintained after the other playgrounds were turned over to the city.

During the war Armco colored club was maintained, consisting of six dormitories, a restaurant, a bath house, laundry facilities and a hall for recreation and assembly, in which is a barber's chair, billiard and card tables, a lunch stand, a piano, and reading and writing tables supplied with free stationery, good literature and magazines. These facilities were supplied to the colored workers of the plant at a charge which barely covered the cost of maintaining them.

The company also found that it would be better to secure special workers to deal with the people from the mountains of Kentucky and West Virginia who were coming to Middletown in increasing numbers. These people were suspicious of any one who did not come from their part of the world and efforts to cooperate with them in improving home and sanitary conditions were practically futile until, through the assistance of Berea College, two of the finest of Berea graduates, a splendid man and wife, were induced to come to Middletown and devote their lives to the service of their people.

From 1917 until the summer of 1921 the company maintained playgrounds under the care and supervision of its own playground supervisors, but in the summer of 1921 these playgrounds, three in number, were turned over to the city, the playground in Bon Veue, however, still being administered by the company.

The head of the mutual interest department is in charge of all these activities. Nor are his duties limited to mere supervision. He is himself busy in brushing away domestic troubles, assisting bereaved families when death has entered, in fact, officiating in nearly all kinds of trouble to which mankind is heir.

In addition to these activities which are administered by the safety and mutual interest departments, Armco maintains other service branches reporting to the director of safety and labor or directly to the head of the personal service division.

Among these are the parks which are maintained around the works. Little flower gardens are laid out almost in the center of the plant, for the grounds around the build-

The Armco Grocery

ings are kept clean and the premises made as attractive as possible. The company believes that the environment of the worker is a very potent factor governing the quantity and quality of the work he produces.

Since 1917 the Armco grocery has been in operation in connection with the stores department. At this store Armco families are able to buy their groceries at a considerable saving over prices in privately owned groceries in the city.

In the winter of 1911-1912 the company made its first venture into the club and restaurant business when it opened a restaurant in the basement of the main office at the East Side Works to serve luncheon every working day and other meals on special occasions. The clubs and restaurants operated by the company have usually been conducted at a loss because of the desire of the company to serve its employees, rather than to make a profit from caring for their needs. Their management has been under the stores department. This restaurant and its successor, the East Side cafeteria, have served the superintendents, foremen and other Armco men in order of their application, and has been of great value in stimulating the exchange of ideas between these men.

The Armco bachelors' club was opened in July, 1916, to provide dormitory and dining accommodations for Arm-

co men without families. The building in which it is located was remodeled to give facilities for housing forty-two men, and with a spacious dining hall, a kitchen, two locker rooms with shower baths, a study room and a social room.

The Armco colored club, whose facilities have previously been described, was opened in the spring of 1916. Prior to this, it had been operated during the summer months of 1913. On January 31, 1921, the colored club was closed because the number of colored men employed by the company had greatly decreased, and seven days later the Armco East Side cafeteria was opened to take the place of the East Side restaurant which had been closed on February 4.

In September, 1916, the company purchased the property owned by the Middletown City Club. Gradually the personnel of the club came to be composed entirely of Armco men, and in the spring of 1917 the present name of Armco Triangle Club was adopted. This club since 1918 has not furnished permanent lodgings but has served as a convenient and suitable lodging place for any visitors to whom the company desires to extend hospitality. On January 31, 1921, the management of the Triangle Club was transferred from the stores department to the general management.

The company in April of 1914 began to issue the Armco Bulletin which serves to bind the Armco men and women more solidly into a cooperating organization moving forward toward a common end in full understanding each of the other. The first number contained but eight pages. A year later it had grown to six times its original size and since that time has contained from forty-eight to sixty pages. A better quality of paper has been adopted and the photographic illustrations have been greatly increased both in number and quality.

These departments, concerning themselves with the personal side of the industry, interested in safety, home conditions and plant morale, have been the result of a gradual evolution accompanying the growth of the business. They have successfully striven to represent the personal side of the management to the men of the plant, to help solve their personal problems, and dealing on a basis of mutual confidence and respect to hold the human element in business.

Chapter XXI

Training ARMCO Men and Women

Public Night Schools—Educational Committee Appointed—Beginning of Americanization Education—Training of Colored Employees—Training of Apprentices—Organization of Training Department under a Director of Training—Trade Apprentice Courses—Office Apprentice Classes—General Apprentice Course—Customers' Salesmen's Course—Foreman Training—Other Courses—Correspondence Section—Americanization.

THE American Rolling Mill Company has for some years conducted educational work because of its belief that whatever helps Armco men to become mentally more alert, to understand their jobs better, and to appreciate the meaning of work they see going on about them, makes them of more value to themselves and to their work.

In the fall of 1913 the need of special classes for the instruction of Armco employees was making itself felt, but in view of the fact that the Middletown public schools started night classes at that time, it was decided to postpone the initiation of any training work at the mill. The public night school, however, was discontinued after two years.

By the spring of 1916 the need had become so great for education of the foreign-born workmen in the plant that a committee was appointed to instruct them in English and in American government, and to assist in procuring their first citizenship papers. This work was carried on for several months under the supervision of the mutual interest department.

During the latter part of the same year the employees of the plant were increased by a heavy influx of negroes, necessitating a school where they could be taught the common branches. A colored man was employed to assume this responsibility, and the school for colored men was successfully conducted for several years.

About the same time the educational committee took over the supervision of the training of mechanical and electrical apprentices as this work had grown to such proportions that it could no longer remain a purely departmental affair.

Educational Department

To handle these increased responsibilities a larger educational committee was appointed whose membership in time grew to seven. One of the first acts of this enlarged committee was to recommend that the educational work should be put under the executive direction of one man to coordinate and administer all the educational activities of the company. As the result of this recommendation a director of training was secured and the training department was organized in August of 1918. Since that time the educational committee, relieved of its executive duties, has continued to function in an advisory capacity.

The training department of the American Rolling Mill Company is organized solely to promote the vocational efficiency of Armco men. The company provides such education as contributes to social and civic welfare only when it is reasonably certain that such social activities and civic training will aid Armco men to be more intelligent citizens and therefore more efficient men.

Training, education, technical skill, and high ideals have always been considered essential factors in the making of Armco products. So the aim of the training department has been to make men better workmen on their jobs and better citizens in the community. To this end both technical and general courses have been given. The extent to which the training department actually touches Armco men and women, and the nature of the courses which it offers, are indicated in the report of its work for the year 1921.

Applied Science Courses—	*Enrollment*	*Certificates Awarded*
Chemistry	19	8
Metallurgy	41	5
Physics	10	3
Electric repairing	21	..
Business arithmetic and slide rule	46	..
Shop mathematics	10	..
Drafting	17	1
Blue-print reading	17	3
Business law	26	6
Industrial history and economics	13	..
Salesmanship	6	..
Filing	17	..
Transcribing	14	..
Shorthand	73	7
Typing	68	5
English	38	6
Foremanship	108	65
Company organization and personnel	42	..
Computing machines	50	7
Gas making	32	..
Gas and electric welding	19	3
Official guide's course	6	..
Public speaking	48	25
French	15	..
Spanish	19	7

Americanization Class

Customers' Salesmen's Course	51	51
Co-Operative students—University of Cincinnati	16	..
Trade apprentices	44	10
Shop mathematics	44	..
Drafting	44	..
Office apprentices	22	22
Correspondence	22	..
Business law	15	..
Computing machines	10	..
Shorthand	22	..
Business arithmetic	22	..
Transcribing	22	..
Typing	22	..
Filing	22	..
Organization	22	..
Total Number in Applied Science Classes	1109	234
Americanization—		
English—men	91	38
English—women	3	..
Citizenship	22	14
Totals	116	52
Business English (Interplant Mail)	400	..
Armco Letter Bulletins (Outside)	200	..
	600	
Grand Total	1825	286

Armco Foremen Discussing Sheet Mill Scheduling after an Evening Dinner

It will be seen from this report that activities of the department cover a very wide field. Apprentice courses are given to develop skilled molders, machinists, electricians, blacksmiths, and brick layers. The training given includes both practical work in the shops and classroom instruction to enable the apprentices to attain the greatest possible skill in their chosen work.

Young men with a grammar school education or its equivalent are admitted to a two months' probationary course, after which, if they have shown the natural inclination and special characteristics necessary for their chosen work, they are definitely accepted as apprentices. For this trial period apprentices receive the regular rate of pay for first year apprentices.

Apprentices are not required to indenture themselves, for the company feels that it is better to offer inducements which will attract and hold the interest of the apprentice until he completes the course. Apprentices receive pay for required classroom work. In no case is this less than the common labor wage and in no case more than 150% of the common labor base rate. A bonus of $100. is paid to each apprentice who completes the course, and an additional bonus of $50 is paid to each apprentice who remains with the company six months after the completion of the course. The company gives to each apprentice who completes his course a certificate of apprenticeship, approved by the National Association of Corporation Training

For office training the department gives two courses. One of these is for experienced office girls from other establishments who are given a short intensive course in Armco's way of doing things. The other is designed to train girls who come with little or no experience.

This second course follows a work and study plan. In the morning the apprentices study typing, shorthand, filing, dictaphone operation, correspondence, Armco office practice, and Armco personnel and organization. In the afternoons the girls are sent for two- or three-week periods to the different offices for practical experience so that when a vacancy occurs in any office it is usually possible to recommend a girl who has had some experience in that office. During the period of training the girls receive about half pay. Thus they learn by doing, and earn while learning.

To develop and train prospective salesmen and minor executives a general apprentice course was organized. The first class graduated from this course in 1919. The classes are limited to six men and the normal length of the course is two years. The applicants for this course are required to be men of good physique and address, and preferably with a college or technical school education, although satisfactory business or industrial experience is sometimes accepted in lieu of school training.

The course consists of two parts: a schedule of practical experience in the general offices and in the various departments of the operating division, alternating on two-week shifts with a definite course of study. The course of study includes metallurgy, heat treatment of iron and steel, chemistry, business law, economics, industrial history, salesmanship, and problems of plant management. These two parts are operated on the half time plan, the apprentices being paired so that each pair will provide one man on the job in the plant all the time.

One of the unique features of the Armco training department is its customers' salesmen's course. Every month each of the culvert companies associated with Armco is invited to nominate one salesman to come into the plant for a course of study in the manufacture and properties of Armco Ingot Iron. The classes are limited to eight men and ordinarily last for three weeks. The program includes: lectures by different members of the company, some study and discussion of text-books, several days of observation in each of the important operating department and finally the preparation of a paper on some phase of the course. Up to 1920 this course was offered to culvert salesmen only, but it is now open to the salesmen of other Armco products and several companies have sent their men to take the course.

The training of foremen has made up a part of the program for the past two years. But in the fall of 1920 it was decided to conduct the foremen's class on a new plan. Under the guidance of a foremen's cabinet made up of a half dozen of the men, who had shown the greatest interest in the work, and an advisory committee of department superintendents the foremen in this course took up for discussion topics of organization and leadership in which they had a vital interest. The personnel of these two advisory

committees was constantly changed to bring fresh minds and new ideas into the course.

Another distinctive feature of the foremen's training work was the weekly foremen's bulletin which was sent to all the foremen in the plant. Each bulletin gave a summary of the discussion of the previous meeting, and served as an invitation to the next meeting, at the same time proposing questions to provoke preparation and discussion for the meeting. An instructor from the department of vocational education of the University of Cincinnati was secured who contributed greatly to the success of the class through his ability to teach and to arouse discussion and argument.

Under this leadership, although attendance was purely voluntary, the class grew from an original enrollment of seventeen to a final enrollment of one hundred eight. Of those finishing the course, seventy-eight had qualified with the required attendance record to take an inspection trip to several of the larger industries of Dayton, Ohio. This trip served as a fitting conclusion to a course which had been of practical, vital interest throughout and the success of which was fully demonstrated in the large and sustained increase in attendance.

In addition to the technical courses, which are taught by the experts selected from the various departments in the mill, the training department has from time to time as needs and demands have suggested, given such special courses as official guides course, computing machine operation, tracing, and public speaking.

The correspondence department was organized in 1919 in charge of an expert supervisor. The purpose of the correspondence advisor is to place all Armco correspondence on the same quality plane as is maintained by all Armco products. His task is to help and interest all Armco correspondents in maintaining this excellence. To such an extent has this been accomplished that the correspondence advisor has become not only an important adjunct of the Sales Division, but he is a constant consultant on problems of correspondence, of all our district offices and many of our customers and distributors.

At the time the training department was organized the need for Americanization work was less acute than it had been for several years but it was still a problem. The

teaching of English is an important part of the Americanization program. This work is divided into three grades of work. The first, beginners' English which included those who could not speak English or who could speak English but could not read or write in any language. The intermediate grade included those who could read, write, and speak a little English. The advanced grade included those who were studying the history of the country, its government, and the things which would aid them in securing second citizenship papers.

In normal times each class numbered six or eight in attendance and met for an hour and fifteen minutes twice a week. The period was divided into three parts: conversation, reading, and spelling and writing, the last two subjects being taught at the same time. The emphasis in the beginners' classes was on conversational English in order to develop a working vocabulary as soon as possible. The intermediate work was based on a simple reader or first lessons in American history. Advanced classes studied American history, civics, and topics of the day.

The company has never made any distinction between native and foreign-born labor as to working conditions except in so far as the inability of the immigrant to speak English made it impossible for him to do certain jobs. But because of the persistence with which the foreign-born employees of Armco have studied the English language and have assimilated American customs and American ideas the large majority of them have been enabled to secure jobs in practically all the departments of the plant where many of them hold responsible positions. Their knowledge of the language is so complete that there are practically no accidents at Armco due to ignorance of English. When this point was reached in the education of the foreigner, the English and citizenship classes were discontinued. This was not done because of a belief that the foreign-born people of Middletown were thoroughly or sufficiently Americanized but because further expenditures for Americanization work on the part of an industrial concern did not seem justified.

The educational work which the American Rolling Mill Company has undertaken has been done with a firm belief that "A business grows as its men grow." It has not been based solely upon a policy of altruism but has grown from the belief that whatever makes men better

workmen and better citizens will be to the profit of the company which employes them. Whenever it is felt that a further expenditure of company money for education will not result in increased efficiency no expenditure is made. The training department carries its work to this point, giving technical and general training to the men and women of the organization to increase their value to themselves and to the company.

Armco Orchestra and Chorus 1921

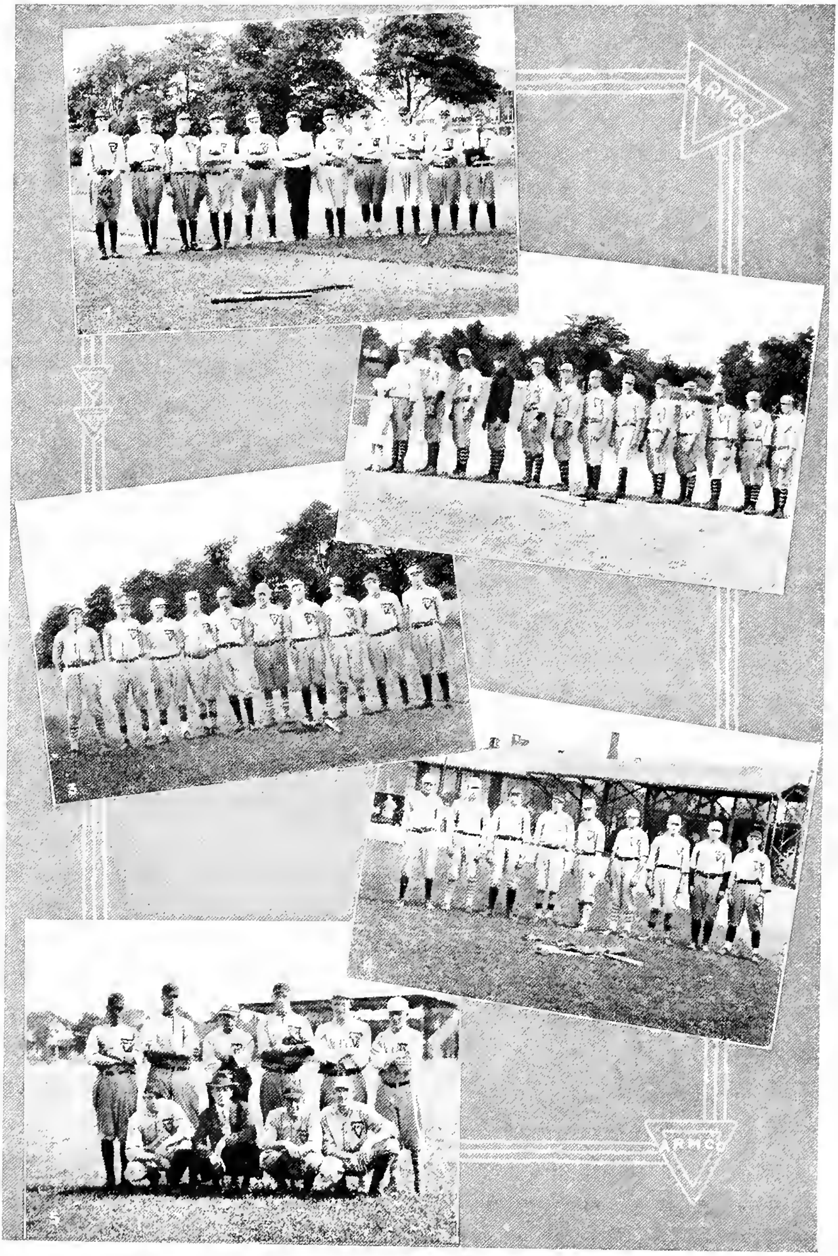
Chapter XXII

The ARMCO Association

Organization Mutual Benefit Association—Growth—Change in Benefits—ARMCO Social and Athletic Club—Merger—Workman's Compensation Act—Athletic, Social and Dramatic Activities—Baseball—Field Meets—Foot Ball—Basket Ball—Tennis—Dances—Card Clubs—ARMCO Girls' Unit—ARMCO Foreign Club—Colored Club—National ARMCO Day—ARMCO Band—Sunday Afternoon Concerts—Help of ARMCO—Permanent Home.

IN the year 1903 Middletown celebrated its hundredth birthday with a parade that did great credit to the city whose population was then about nine thousand. In this parade the employees of The American Rolling Mill Company won a prize of twenty dollars for having the most men in line. With the money thus obtained they started the forerunner of the present Armco association and named it "The American Rolling Mill Mutual Benefit Association of Middletown, Ohio." To this twenty dollars prize money, the company added eighty dollars, launching the new organization with one hundred dollars in the treasury.

The organization meeting was held on a hot July afternoon in 1903 in the Redmen's Hall, just south of the City Building. About eighty men were present and after a discussion of about thirty minutes they voted to accept the suggestions offered by a committee of prospective members. The suggestions were in part as follows: "That the object of the association be to afford relief to any of its members who might be prevented from performing their duties by sickness or accident; that an entrance fee of one dollar be charged; that the monthly dues be fifty cents; that five dollars a week be paid for sickness or accident, and fifty dollars in case of death; that only employees of The American Rolling Mill Company should be eligible to membership; that the officers should consist of fourteen directors, said directors to choose from among their members a president, vice president, secretary and treasurer; and that each department should be represented on the board of directors."



Armco Base Ball Teams, 1920

The drafting of a constitution and by-laws was left entirely in the hands of the board of directors. The directors were not slow to act upon the duty delegated to them and within a week they had drawn up the constitution and by-laws and had authorized the printing of one thousand copies. The by-laws were in the main unchanged until 1911 when they were thoroughly revised. From time to time more copies of the constitution and by-laws were printed, in several instances in foreign languages.

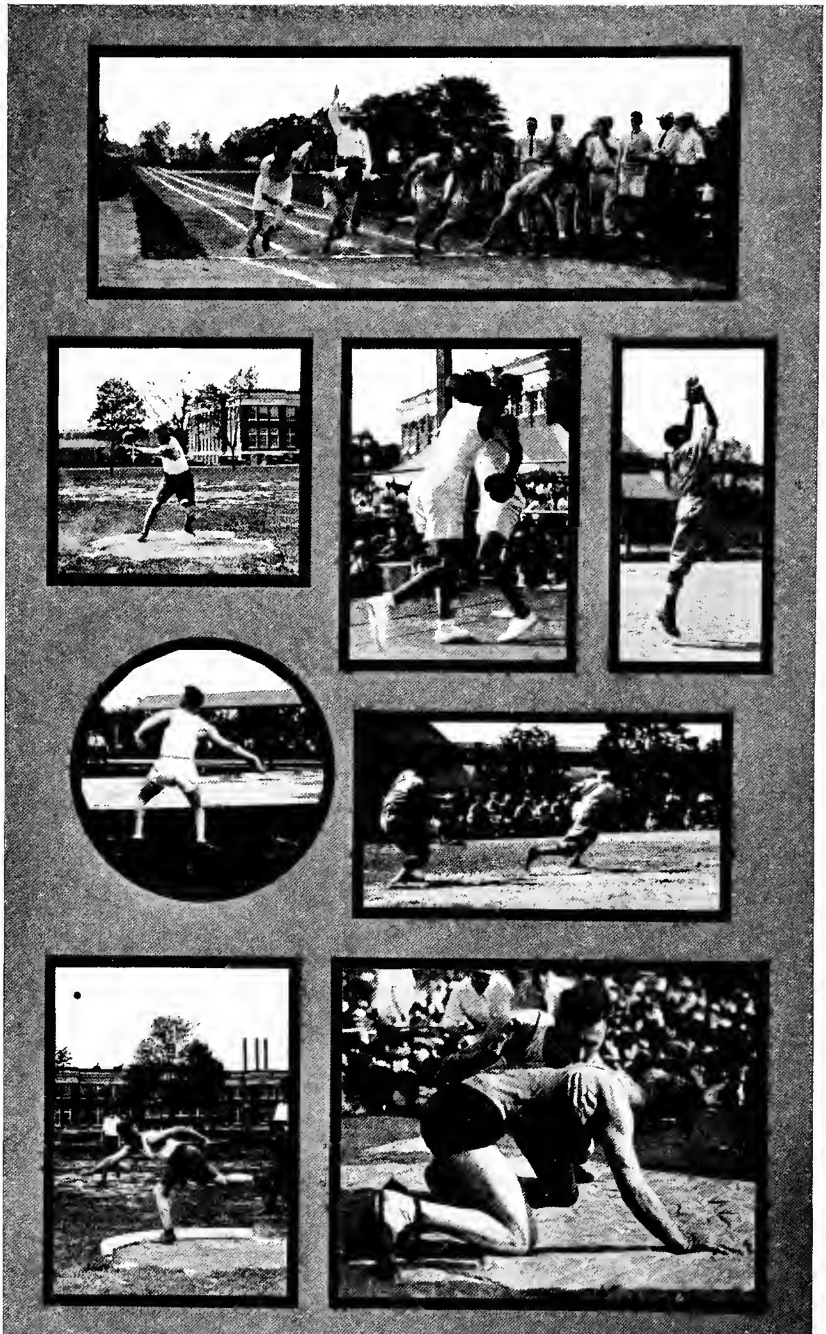
The board of directors met once a week, often in the mill office at first, sometimes at the gate or in some department of the mill, and later in the office of one of the local attorneys.

Though organized as an insurance association the mutual benefit association very early began the policy of holding socials and entertainments. Before the association had been in existence three months, records of these affairs appeared in the minutes and grew in frequency and size from year to year.

On the eleventh of November, 1904, The American Rolling Mill Company notified the board of directors that it would pay all necessary surgical bills of the members and would do everything in its power to further the interests of the association. On the 26th the benefits per week were raised from five to six dollars for men incapable of performing their manual labor. At the end of this month, which was the 17th month of the association history, the membership had grown from the original eighty men to two hundred twenty-five.

At the close of the succeeding year, 1905, the association had enrolled practically seventy-five per cent of the men in the plant. From this time on the membership grew steadily until by 1911 and 1912 practically every man in the Middletown mills was a member of the association. In effecting this growth in membership the company was very influential because of the hearty support it gave the association in all of its plans.

After 1905 when the benefits were raised to six dollars a week for thirty-nine weeks, no further changes were made in the payment of benefits until January of 1912, when the association voted to pay eight dollars a week benefits for sickness or injury for a period of thirty-nine weeks, the benefits however not to begin until after the first week. This proposition was discussed at a general



Scenes National Armco Day

meeting on January 12 and unanimously adopted. Under this arrangement the association soon discovered that it was in danger of being forced deeply into debt, so seven months later a general meeting was held in the K. of P. Hall to vote on a reduction of the benefit. The members voted to reduce the benefit to six dollars a week and to leave the other terms of the article unchanged. This decision which has not been varied since that date has made the Armco association one of the few benefit or insurance associations in the country paying a substantial benefit for such a length of time as nine months. At this meeting a proposal was made that the board of directors should have power to levy an assessment whenever the reserve should fall below $3000 but this proposal was defeated after a protracted discussion.

An Armco club of a social nature had been organized at the Zanesville plant in 1911, and the men of the Middletown plant felt that they would like to organize a similar club. So on the 7th of December, 1912, the mutual benefit association appointed a committee to draft a plan of organization for such a club. A little less than a month later after the general meeting of the mutual benefit association adjourned an organization meeting of the Armco social and athletic club was held and an organization committee was appointed.

By the middle of February, 1913, this committee had fully completed its work. A hall had been secured and about two hundred members met on the fourth floor of the Sorg Building in what was to be the club's regular quarters for almost eight years. The regular executive officers

The Start of Mile Run

WINNER CROSSING THE LINE

were elected and a board of governors was provided to manage the affairs of the club.

In March active work for the Armco association's first minstrel show was begun. This work bore fruit in the fall of 1913, when the first minstrel show of the club was given before a well filled house. The minstrel show has proved a permanent and popular club activity.

In March, 1913, the first pool tables were installed and a gift of magazine subscriptions, books, and book cases by the company was appreciatively accepted by the club. Affairs of the club were well under way by this time, and the final step in organization was completed when the committee on constitution and house rules completed its work by submitting its findings to the board of governors on March 15, 1913.

In many ways it was felt that it would be advantageous for the mutual benefit association and the Armco social and athletic club to combine. The first step toward this action was taken by the board of directors of the mutual benefit association on August 2, 1913, when they appointed a committee to submit such a proposition to the board of governors of the Armco club. On the 13th of October the board of governors voted to take such legislative steps as were in its power to permit the Armco club to be absorbed as soon as possible by the mutual benefit association with the understanding that the present board of governors and officers be continued in power as an Armco club committee; and that their successors be elected as the constitution of the Armco social and athletic club provided.

Hair Dressing Contest, National Armco Day

Some negotiations were necessary before the merger could be effected but it was finally completed on September 23, 1914, on practically the same terms as those laid down by the resolution of the board of governors of the Armco club. The new association continued to be governed in this manner until 1916 when a director was secured. At this time the Armco club committee was found to be unnecessary and so ceased to function.

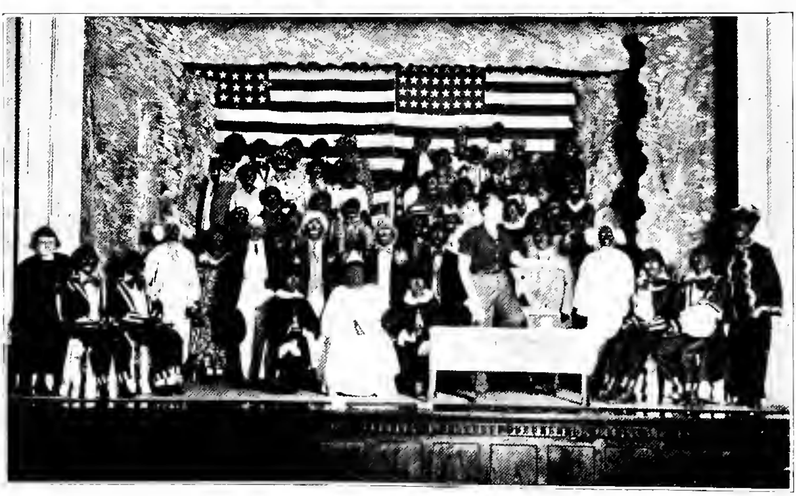
The merger of the two associations was also affected by the fact that at this time the workmen's compensation act was to go into effect, paralleling in many cases the work of the benefit association. It was found that the previous dues of the benefit association would make it possible to pay the regular benefits in any case not covered by the workmen's compensation act and at the same time provide for the development of the social side of the club. So an amendment to the constitution was adopted which provided that the mutual benefit association should be released from the payment of benefits in those cases of injury or accidental death covered by state insurance.

After the merger of the two organizations under the name of the Armco association the club had a steady and healthy growth, taking over, as it was able, the direction of new activities and increasing the scale on which the old ones were operated. Practically every sport has been played under its auspices, some for a season only, some every year.

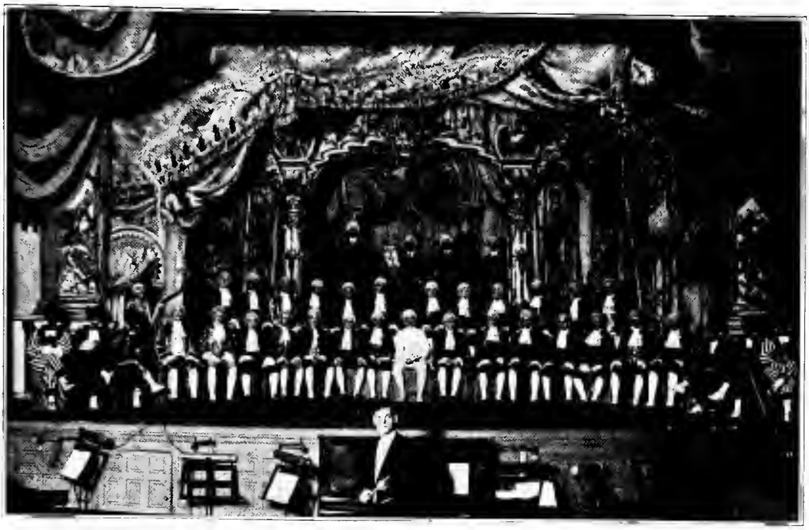
Baseball was the first sport to attain prominence in the club's activities and has always held the major place.

In 1913 the first Armco baseball league was organized with six teams playing on Saturday afternoons. The number of teams remained unchanged until 1917 when it was reduced to five, the number of teams maintained since that time with the exception of 1918 and 1921 when only four teams took part in the league contests. In 1914 a baseball commission was appointed with a director of baseball to take executive charge of the baseball league. In this year the games were played on Saturday afternoons and Sunday mornings. This time of playing proved unsatisfactory, so in the next year the games were played on Saturday and Sunday afternoons, the Sunday games being played at the Middletown ball park. This arrangement was continued until 1919, when the first regular Sunday afternoon ball was played on the Armco field by a picked representative team. This arrangement was continued until 1921, the Armco league games being played on Saturday afternoon and the representative team playing on Sunday. However under this plan Armco baseball was beginning to savor of semi-professionalism; so, in 1921, the representative team was discontinued and regular league games were played on Sunday afternoons as well as on Saturday. Four teams took part and a great deal of interest was manifested by the whole organization.

Five of these annual field meets had been held in succession when the industrial conditions of 1921 made it



The Armco Girls' Minstrels



The Armco Men's Minstrels

necessary to omit them in that year. The omission, however, was for the year only as the field meets had been of so much interest that no one thought of permanently discontinuing them.

Until 1918 Armco had no tennis courts of its own but tennis tournaments were held on the city courts and on some private courts about town. In 1918 two asphalt courts were built on Armco field and in 1920 two clay courts were built on the other side of the garage. These courts not only serve for the tournaments but have been very popular ever since.

Winter each year brought out the billiard and pool contestants who competed in tournaments on the association tables. Checkers, chess and card tournaments also supplied cause for high rivalry during several winters.

Until 1916 the active management of both the athletic activities and the social affairs of the association was vested in a social and athletic committee of three members. By 1916, however, the work of the Club had grown to such an extent that a manager who could devote his entire time to the project was hired. With the coming of a manager to direct the club old activities took on new life and new ones were instituted. In the years from 1916 to 1921 the association grew by leaps and bounds.

The Armco dance program grew steadily until under three different committees there was a dance practically

every week. The first of the regular Armco dances was given in 1913 by the Armco association. The Armco girls were next in the field in 1915 and in 1916 the dancing program was completed by the organization of the Armco folk dancing society. In the summers of 1919 and 1920 summer dancing was provided on the Armco tennis courts, and in 1921 a good dance platform was built on which dances were held every Friday night through the summer months.

The first Armco card club party was given on November 1, 1917. Prior to this there had been occasional card parties by groups who had been interested in organizing them, but this marked the beginning of Armco card parties on a large scale. In 1920 one of these card parties given in the old Armco club rooms had six hundred people in attendance, and the program of cards, lunch, and dancing proved very popular.

Dramatic plays were also encouraged and for a time a dramatic club flourished, producing in 1918 three short plays before the public in the Sorg Opera House and contributing to the entertainment on several Armco Friday nights in the Armco auditorium.

Meanwhile the Armco girls had organized into "The Girls Unit of the ARMCO Association." The Armco girls had given dances since 1915 and during the war worked loyally in behalf of the Red Cross and other war organizations. Out of these activities grew the girls unit of the Armco association, which had its first regular meeting on March 31, 1919, in the Armco auditorium. The unit was divided into various subsidiary groups or committees to take an active part in directing the activities of the unit. The first list of committees included those for calisthenics, dancing, art, history, music, etiquette, sewing, domestic science, and dramatics. These changed from year to year as the interests of the girls shifted to new fields. The dancing committee carried on the Armco girls dances; the calisthenics committee organized a gymnasium class and secured a gymnasium instructor; and the various other committees of the unit each served in their respective fields.

Though handicapped by the lack of a proper meeting place and facilities for carrying on their work, the Armco girls accomplished a great deal. Shortly after their organization they petitioned the Women's Federated Clubs of Middletown for membership, which they obtained.

In subscriptions to various benevolent enterprises the Armco girls unit was always very active and their liberality in these matters stimulated them to many efforts in other lines. Noteworthy among their productions was the Armco girls minstrel show which was given in the spring of 1920. This show was given three times in the Armco auditorium and many persons were turned away each time for lack of space. Lawn fetes, carnivals, and dances have helped to supply the girls unit with funds for carrying on their benevolent work.

Another unit of the Armco association which has not been previously mentioned is the Armco foreign club, which was organized in 1912 at practically the same time as the Armco social and athletic club. The company and the association combined to put the foreign club on its feet, and since the first years it has been practically self-supporting. Its membership has run from a maximum of about five hundred men which it had in 1914 and 1915 to not less than two hundred men in 1921. This club assists foreigners in becoming American citizens, provides them with a place where they can hold their meetings and secures for them a place where they may read, write, play billiards and pool, and pass their idle hours in a pleasant wholesome environment. The capable secretary of the club not only manages the club's affairs but he assists the foreigners in the conduct of their business matters. Since its founding the Armco foreign club has been located in a pleasant stucco building in the midst of well-kept grounds on the bank of the Miami and Erie Canal near the Central Works. It has been a very potent force in providing for the foreigners the same facilities for self-expression and development that the Armco association affords to its American born members.

As it became financially able, the Armco association gradually expanded into various phases of work which were not contemplated in the early years of the organization. As the number of colored men in the employ of the company increased, it became increasingly desirable that they be given club privileges also. Due to the state of the association's finances, the company had to initiate this work, but, as rapidly as possible, the Armco association has been taking it over. In 1920 an Armco colored baseball team was organized and in 1921 a platform for dancing was erected weekly in the Armco garage for their use.

This platform during the summer was erected for a dance for the colored employees each Thursday night, on Armco field.

On September 25, 1920, the Armco association attended to all the details of national Armco day, which was an immense carnival day for Armco people. The men of the Zanesville plant with their families and some of the employees of the Columbus Works came to Middletown for the day. The Zanesville band proved an inspiration to the men of the Middletown plant. It was estimated that twenty thousand people were on Armco field participating in the many events which the committee provided. Races, boxing matches, outdoor motion pictures, baseball, dancing, and a host of carnival attractions kept everyone in good humor and made this day memorable in the history of Middletown and Armco.

On April 1, 1921, the Armco association took another important step when it secured the services of a well-known conductor to direct an "Armco band." The men in this band gave their services and bought their own instruments, serving freely for the love of music and the chance to be of service in the community. The association furnished only the uniforms, and the director. Throughout the summer of 1921, this public spirited band gave programs of excellent music every Friday night, which were exceedingly popular and attended by thousands of people.

This, however, was not the association's first venture in the musical field. During the entire winter of 1920-1921 the association provided Sunday afternoon concerts for its membership free of charge in the Armco auditorium. Part of the talent for these concerts came from Middletown and the Armco organization, but the largest part was secured from the Cincinnati Conservatory of Music and other outside musical centers.

Following the successful musical season of 1920-1921, an Armco orchestra and Armco choral society were organized with a large and enthusiastic membership.

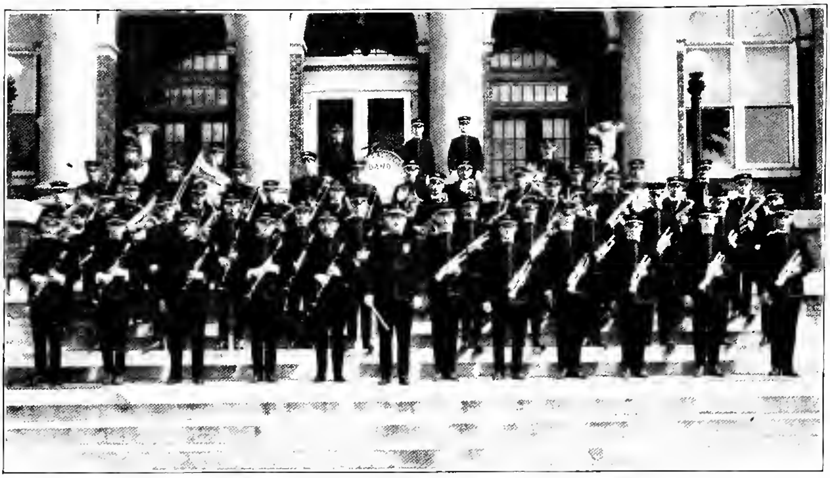
This growth in the association's activities, however, was but a part of the growth of the organization as a whole. Though in its most poverty-stricken days the club never was more than fifty dollars in debt, this expansion of its activities could not be made until adequate means of financing them could be found. The growth in membership partly brought this about but even then the asso-

ciation was severely handicapped financially. But on January 1, 1921, the company which has always shown a desire to aid the association, agreed to put into the association an amount equal to the dues paid in by its members.

One of the substantial results of the help received from the company was the securing of the permanent home into which it moved in July, 1921. The quarters of the club had been gradually expanded during the years of its growth. At first only the fourth floor of the Sorg building was leased. Then more space was acquired until the Armco association in addition to the fourth floor occupied a large part of the third floor as well. On this floor the pool and billiard tables, the cigar stand, the reading and card room, and the office were located. The floor above was given over to a large hall which served as a gymnasium, dancing hall, banquet hall, and assembly room, a stage, a kitchen, and locker room and showers. After the first year, these rooms were never used by any organizations other than the Armco association and the Company except during the war when the Red Cross was offered the use of a part of the rooms.

These quarters, however, were not sufficient for the needs of the organization and as they were held under lease, could not be used after 1923. The purchase of the store building which had formerly been used by the Mathes-Sohngen Company, located directly across the street from the Sorg building, gave the association a permanent home which could be adapted to fit their needs in a very thoroughgoing fashion, though at the time the association moved into the rooms it was not possible to do some remodeling which would have been very advantageous. It is worthy of note that the Armco association was able to move all its furniture without any expense because of the loyal help of its members who themselves did the work of moving. In its new building with a stronger financial basis than it had known at any time, the Armco association entered into the winter of 1921-1922 with greater possibilities of usefulness than it had ever known before.

Throughout its development the Armco association had labored to make life for the workers in The American Rolling Mill Company more worth while. It has been the instrument through which the men in the plant have secured for themselves those social and athletic activities



which they desired. To the extent that it has succeeded in developing a happy contented membership, the Armco association has become a great financial asset to the company, justifying the investment which it has made in the club. The association has always taken its inspiration from the vision of the men in the plant who have worked toward their ideal of sustaining each other in times of injury and sickness and of developing the best possible social and community life among the men and women of Armco.

Chapter XXIII

ARMCO in the Great World War

ARMCO Ambulance Corps—ARMCO War Fund—Shell Manufacture—American Rolling Mill Gun Carriage Company—Part in War Drives—Men in Service.

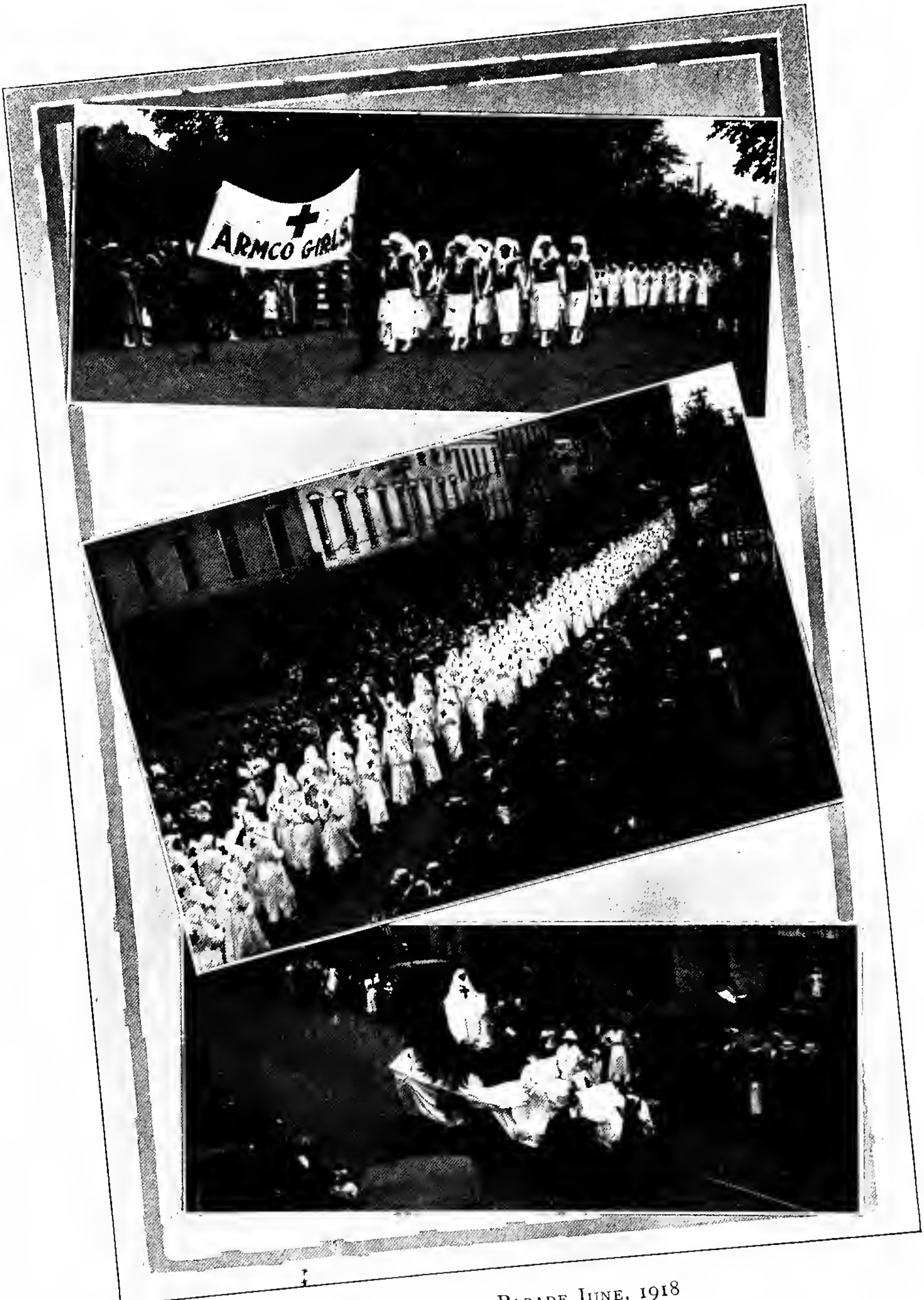
ARMCO is justly proud of the service record which its men and women made in the great World War, for each and every one of them served faithfully either at home or abroad. Some were chosen for one service, some for another, and those who stayed at home served together faithfully and efficiently in many ways.

Armco's first war effort was to organize and equip the now famous Armco Ambulance Corps, whose work and service is discussed in another chapter.

The next effort was the creation of an Armco War Fund, which grew to the substantial sum of $112,711.82. This fund was created to help, as far as such help might be needed, Armco men who returned with their earning capacity impaired because of their service in the war.

Armco products played a part in many phases of war services. Mines made of Armco Ingot Iron were stretched in a great chain across the North Sea as "jail bars" against the German fleet. "Armco" Ingot Iron was the companion of dreadnaughts, battleships, and torpedo boats as it floated in the water keeping watch to send to the bottom every enemy vessel which might attempt to reach the high seas.

For the U. S. Navy, Armco supplied single and multiple throw crank shafts for various types of vessels from officers gigs to submarines. The submarine chasers which served so effectually to fight the submarine menace in the North Sea were made in large part from Armco products. For them, Armco made various heavy forgings, collar line shafts, tail shafts, and rudder posts. Much of the sheet metal of the super structure was made from "Armco" Ingot Iron. For the engines of the Emergency Fleet Corporation, Armco made crank pins and crank disks. Many of the Emergency Fleet Corporation ships



Preparedness Parade June, 1918

were also equipped with collar line shafts, propeller shafts, and rudder posts made by The American Rolling Mill Company.

In the air, also, Armco products were of service. In the famous liberty motors "Armco" Ingot Iron filled a very important position by meeting the severe tests set by the Government for a satisfactory water jacket. Armco has forged and rough-machined a large number of airplane motor cylinders.

Not the least of Armco service rendered America and the world in arms was given by the working organization at home. Even before America entered the war, shells from Armco were helping hold back the tide of Prussianism on both the eastern and western fronts. Working night and day, sometimes without a roof over their heads, handicapped by sickness and shortage of men, the Armco organization produced in all three million, two hundred and fifty thousand shell forgings for the cause of Democracy.

Nor was this the extent of Armco's manufacturing service in the World War. A firm in Hamilton, Ohio had taken a war contract which it was unable to complete. Labor troubles, engineering difficulties, and mechanical failures attended every step of its attempt to produce for Schneider 155 MM quick firing howitzer rifles. These carriages had to have the precision of a watch coupled with the strength to withstand the recoil of the big gun. Though for months it had been attempting to produce

The Soldiers of Industry on Parade

Comfort Kit sent to all Armco Service Men

under this contract the firm which had it was unable to assemble a single gun carriage capable of meeting the rigid specifications which had been set up.

The ordnance department office at Cincinnati appealed to Armco officials to take over this plant and operate it until the contract was completed. Because the difficulties of administering their own plant were absorbing all their attention Armco at first refused. Then the company's officers were asked to come to Washington where they were requested to take over the plant as a patriotic service. This they did and operated it successfully until the end of the war as The American Rolling Mill Gun Carriage Plant, Hamilton, Ohio.

Armco men and women not only worked faithfully to produce that which the government wanted from time to time, but they gave largely of their effort and earnings to every patriotic purpose presented to them for their support. Armco men and women in Middletown subscribed for $2,007,950.00 in four Liberty Loans issued by the Government; they subscribed $74,187.48 for Red Cross and other war service organizations, making a total subscription for all war purposes of $2,082,137.48. The Zanesville and Columbus organizations did proportionately as well in their respective communities.

In all, nearly seven hundred Armco men entered in one branch or another to do their part to keep aloft the flag of liberty. Ten gold stars in the service flag of Armco tell of the heroism of the ten stalwart brave Armco boys who gave their lives for their country. No sacrifice can compare with theirs.

Chapter XXIV

The ARMCO Ambulance Corps

Organization of the Armco Ambulance Corps—Its Service with the French Army—Citations—Winning of the Fourragere—Welcome Home.

ON May 2, 1919, the steamship "New Amsterdam" arrived in New York Harbor. On her deck, impatient to land, were the men of the Armco ambulance corps returning home after nearly two years in the ambulance service with the French Army in France.

The story of this group of fifteen men, the forming of the ambulance corps and their service during the war, is unique and interesting. Due to the series of unusually fortunate circumstances the men were held together in the same unit during the entire period of their service, an almost unheard of thing in the army.

Soon after the entrance of America in the World War, a few of the Armco men in Middletown conceived the idea of helping along the cause by enlisting as volunteers in the American Ambulance Service that had for some time been operating so successfully with the French Army.

Armco approved the idea and became very enthusiastic about it, seeing in it an opportunity to serve the French fighting forces immediately with some definite visualization of America's really intended help. It was realized that much time would be needed to put into motion America's great war machinery before it could be made really effective; but here was an opportunity to do something quickly that would help uphold the morale of our Allies already so wearied by the three years of intensive fighting.

The idea grew and was taken up actively by the Armco Association as well as by The American Rolling Mill Company itself. A call was sent out for volunteers and men responded from almost every department of the mill both in Middletown and Zanesville. The ambulance corps could only consist of a limited number of men and fifteen were finally chosen representing as nearly as possible the entire organization. They were: A. P. Preyer, C. S. Simpson, Wm. P. Pease, R. P. Myers, H. B. Marshall,

THE SECTION OF S. S. U.

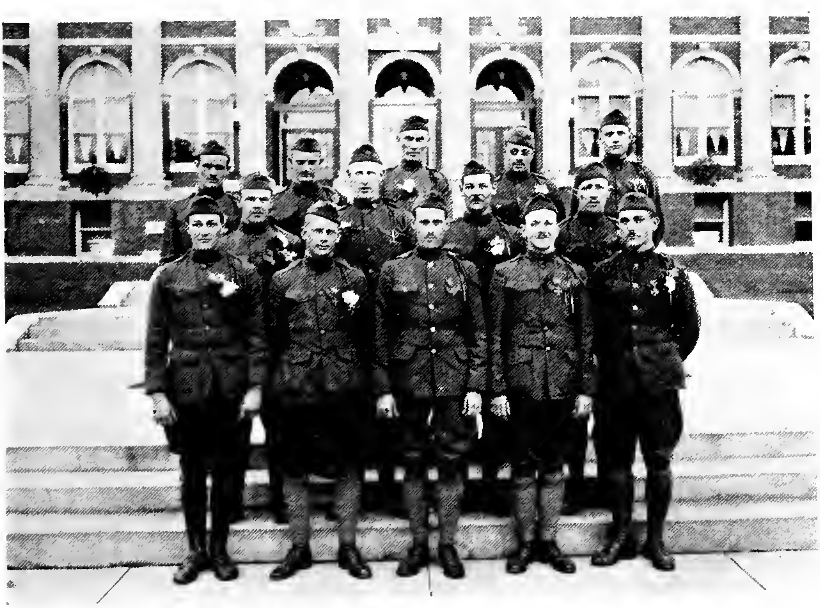
S. E. Graeff, J. E. Bryan, R. T. Maneely, Vaughan Horner, J. M. Beard, Lee Ware, Victor Collord, Sidney Gold. N. E. Ebersole was chosen as leader with H. W. Rinearson second in command.

An agreement was drawn up explaining the ideals and aims of the organization and the obligation of its members to their country, Armco and the corps itself. This agreement was signed by all of the men and a copy kept by each man.

By this time the Armco Association had started to build up its Armco War Fund to which nearly every employee of the company contributed a certain part of his or her earnings. This fund was to be used for the assistance of any Armco man injured in the service of his country, or to lend aid to his dependents if the occasion required it. The American Rolling Mill Company so greatly appreciated the spirit back of this action that it agreed to contribute to the fund a dollar for each dollar raised by the Association.

Originally it was intended that this fund should also take care of the necessary expenses for the equipment and maintenance of the Armco ambulance corps, but these plans were soon changed and no part whatever of the fund was ever used for the Armco ambulance corps. The American Rolling Mill Company, however, took this work directly under its own care and at once made arrangements for the complete outfitting of the whole unit and authorized to be purchased in France seven Fiat ambulances, which were to be fitted out with the best of equipment and to be known as Armco Ambulance Unit for work with the French Army.

It was necessary at this time for some hard and fast work to be done in order that there would be no unnecessary delay in getting started. It was at first thought that the



Armco Ambulance Corps on its Return

New Year's Eve, 1918, in Alsace. French Cook in the Foreground

corps should be attached to the American Field Service that had been doing such splendid work with their volunteer ambulance services with the French Army. It soon developed, however, that this plan would be impossible; and very quickly another scheme, even more attractive, began to work itself out after a conference had been held with Mr. Elliott Norton, of New York. The whole corps then signed up with the Norton-Harjes Volunteer Ambulance Service, which had been operating most successfully in France since the very early part of the war in 1914.

At last, after much difficulty, the passports had been secured and a special car left Middletown on August 1, carrying the boys and some of their families to New York, where they bought their last piece of equipment and set sail at ten o'clock on the night of August 7 on board the French Line Steamer "La Tourraine."

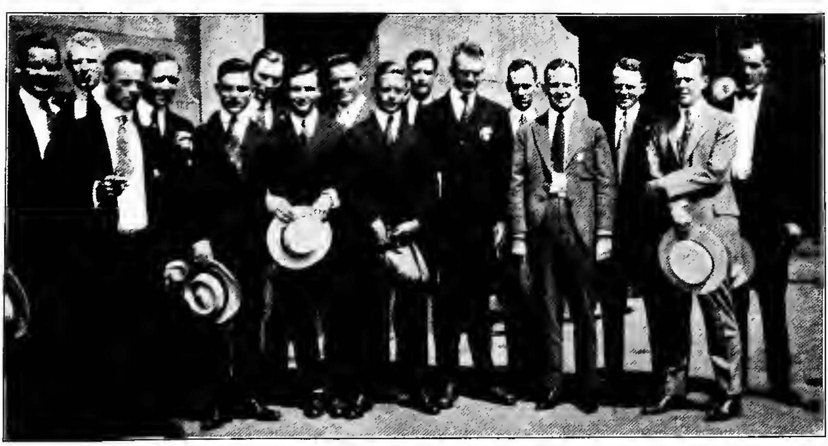
After a twelve days' zigzag journey through the submarine infested waters of the Atlantic, unconvoyed, in absolute darkness of night, the steamer docked at Bordeaux. From there the boys immediately went to Paris where they met Mr. Richard Norton, then at the head of the Norton-Harjes Service. Mr. Norton was a splendid type of man, lovable and kind, an earnest volunteer soldier since the early days of the war when he used his own touring car as an ambulance in the first battle of the Marne.

The corps went at last to the training camp at Sandricourt, ordered its seven ambulances and awaited the formation of the new section to which it was to belong.

Just about this time the first troops of the American Army began to arrive in France and the early plans of the A. E. F. were being laid out. The U. S. A. A. S. (U. S. Army Ambulance Service) under the direction of Colonel Kean and Colonel Jones was one of the very first services on the field and they were very anxious to take over those experienced men who were then working as volunteers in the ambulance service. These plans developed rapidly and soon it was found that it would be impractical for the old volunteer sections to continue as they had done in the past.

The branching of the road was now reached. One of three plans must be chosen immediately. First, the corps could break up and the members go back home in order that those who cared to could enter the officers training school and be in line for a commission; second, each man could enlist in France in the particular branch of service in which he thought he could make the greatest advancement; third, the whole corps could enlist as privates in the U. S. Army Ambulance Service and take the long chance of being held together, and thus in a small way attempt to carry through the original plans as an Armco unit. This last choice had in it much uncertainty, as when it was once made there was no changing, regardless of what the sacrifice might be.

The whole matter was put frankly before the men and they were relieved of any responsibility except that each



At the Dock Ready to Sail for France

THE WELCOME HOME BY ARMCO

man should do exactly what he thought best. The decision was, however, almost instantaneous and unanimous. Fourteen of the fifteen men agreed that they would stick together and take the chance of doing what they could to uphold the original plan of the Armco ambulance unit and in this way fulfill as nearly as possible the services and ideals laid out for them by their Armco comrades at home. This necessitated a considerable change in their plans; as the Government could not accept the Fiat ambulances that had been bought, the order was canceled on September 20, 1917, and the whole corps was regularly enlisted as buck privates in the Army of the A. E. F.

Before actually being detailed to duty, the boys were sent to La Harve to bring back to Paris a convoy of twenty new touring cars that were to be used by the Red Cross. This was their first convoy and it developed into something of a road race through the apple orchards of Normandy, finally ending up by each car separately entering Paris through a different gateway.

Orders were now received instructing the unit to join the old volunteer section 22, which was then stationed at Montiere on Der, near the birthplace of Jeanne d'Arc. After spending some days with its new section learning the ropes, the whole division was ordered into the line just outside of Verdun. Here at a little place known as Markenterre, in sight of the German lines, the boys received their baptism of fire and carried on their first real work under the enemy shell bombardment and within machine gun range. Fortunately, however, no one was injured.

On October 10, the old section 22 was relieved from duty by one of the regular army sections and the Armco boys were ordered to report once more at the base camp at Sandricourt. Here they were joined by a number of others who had enlisted in the U. S. Army after their work in the Norton-Harjes Service. Twenty new Ford ambulances in charge of this new detachment were immediately put under way with instructions to report to Lieutenant Drake in command of section 5 then operating on the Chemin des Dames with the 66th Division of Alpine Chausseurs, one of the greatest of the French shock troops, known as the Blue Devils.

Section 5 had been founded as the first volunteer section in 1914 and had worked with a splendid record on many battle fronts since that time, earning a number of French decorations for conspicuous bravery in action. The section was equipped with large Packard ambulances and contained a personnel of many experienced men, who had been doing effective work with their division preparing for the proposed attack on the Chemin des Dames. Naturally it was a great blow at this time to receive orders to send back to Paris the big ambulances which were being replaced by the Fords and to reorganize the section, replacing those volunteers, who had not signed on with the American Army, by the new recruits going out with the Armco boys. There was much confusion in the reorganizing of the work, but, in spite of all, during the severe work of the attack, which started two days later, the section conducted itself so well under the intense bombardment of the enemy that it was later awarded the Army citation of the Croix de Guerre with palm for the part it had played in the capture of the Chemin des Dames and Fort Malmaison.

The section previous to this time had already won two similar citations, as well as a third of a lesser degree, and was therefore eligible to the greater honor of the Fourragere. The Fourragere in itself is a braided cord which is worn looped over the left shoulder. It is not given to individuals, but only to a regiment or group of men when all members of that group are entitled to wear the decoration. It is a distinction handed down from the early days of the great French Armies, when the cavalry squadrons composed the pick of the fighting forces.

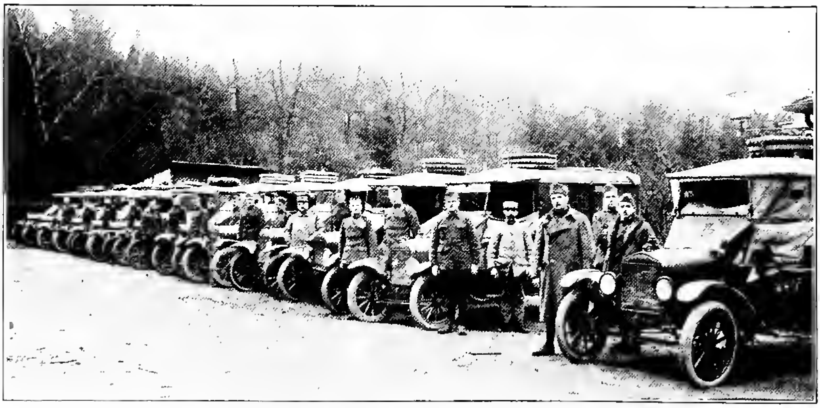
Although the section as a result of this last engagement, coupled with the splendid record of the unit before this

time, was eligible to be awarded the Fourragere, it was thought that such a distinction would be impossible, having never before been awarded outside of the French Army, and even within their own organization this decoration had never been given to a motor unit. It was, therefore, with a feeling of justifiable pride that the section, nearly two months later, received word from the French Grand Headquarters that it had been awarded the Fourragere of the first grade; that is, in the green and red colors of the Croix de Guerre. This was a certain proof of the appreciation of the French for the American aid that had been given them.

The Armco unit being a part of this section during the last action felt proud of their part in the work and that they had, in at least some degree, proved worthy of the trust placed in them by their comrades at home.

After the successful battle of the Chemin des Dames the division was relieved and the boys followed it southward to Chateau Thierry for a period of rest. Here orders came detaching the section from their beloved 66th Chausserts Division. The French General Brissaud Desmaillet shook hands with each of the men, thanked them for the work done during the last successful attack, and promised to ask that the section again be placed with his division in the springtime.

Then followed the cold winter of 1917-18, during which time there was little activity along the front. From Chateau Thierry the section went into quarters at St. Remy Blanzy as a part of the reserve of the 6th army.



The Full Section Ready for Inspection

Here the work was very light and most of the time was spent in trying to keep warm. The official name of the section was now changed from Section 5 to S. S. U. 646.

On November 20, with much rejoicing, the section received the news that it had been attached to the 27th French division, and a hurried night convoy brought them to le Thillay, near Paris, where the first Thanksgiving away from home was celebrated. Early in December the division was again on the move going toward the front and found quarters at Pierrefonds in the shade of the great castle which overshadowed the whole of that little community. The spirits of all were running high but im-immediately fell when orders came detaching the section from the division and sending it once more to St. Remy Blanzy to be held again as reserve. Christmas and New Years were celebrated as well as could be expected, and it was here that the first of the boxes sent from home reached the boys in time to help in the celebration.

The next move was on January 7 when, after unlimited rumors of action, the section moved to the town of Villette near Fismes, where later on occurred such severe fighting by the American troops. The winter dragged on in dull monotony with little action, and it was during such periods as these that the spirits of the men were at the lowest ebb and there seemed to be no end in sight to the unchanging weariness of the war.

Then came the beginning of the great German offensive in March 1918 and the section had much work to do although it was not regularly attached to a strong division.

In April the Army Headquarters decided to double up the section making it a unit of forty cars and sixty men instead of twenty cars and about thirty men. This meant army corps evacuation, which, for the most part, was back from the lines and was always hated by everyone.

However, on May 27, 1918 the German advance along the Aisne commenced, and, by this time, the section had moved to a little town of Fontenoy just west of Soissons.

The advance was so rapid that it was impossible to keep the work in regular order. Most of the cars were running in charge of their drivers who received but little supervision, doing their best night and day handling wounded and keeping from being captured. Very many of the men of their section working in the near vicinity were captured and it

ARMCO AMBULANCE CORPS
FOR FIELD SERVICE IN FRANCE
WITH THE AMERICAN RED CRESS

- - - - - - - - - -

Memorandum of Agreement

WHEREAS the working organization of The American Rolling Mill Company of Middletown, Ohio, hereinafter called the "Armco Organization", proposes to assume the expense incidental to sending an "Armco Ambulance Corps" to France, and to maintain it in the field for the duration of the war; and

WHEREAS it is desired to have an agreement outlining definitely the conditions under which said Ambulance Corps is to be organized and under which its members are obligated to serve; and

WHEREAS it is desired to demonstrate the value of that combination of loyalty, co-operation and cheerfulness in the performance of duty, whatever or wherever it may be, which is the mainspring of "Armco Spirit":

This memorandum of Agreement by and between Mr. George M. Verity, representing the Armco Organization and the Armco Company, hereinafter called the "Sponsor", and the undersigned "Members" of said Corps, W I T N E S S E T H:

First: Said Sponsor agrees to pay all traveling expenses from Middletown, Ohio, U.S.A., to the field of action in France and return therefrom, as well as all necessary expense for equipment and maintenance, including clothing and living expenses, except such part of said expense as may be borne by the American Red Cross, or other agencies which are to be served.

Second: The Sponsor agrees for the Armco Company that said Members shall remain as employees of The American Rolling Mill Company on leave of absence, detailed to special service with the "Armco Ambulance Corps" in France, under the personal supervision of a competent leader elected from their own number, who will be directed by the American Red Cross or some authorized representative of same; such service with said "Armco Ambulance Corps" to be without pay except whatever may accrue through the taking over of this service by the military authorities of France or the United States.

As employees of The American Rolling Mill Company in good standing, with leave of absence for this special duty, their rights as such under the company's Group Insurance Plan now in effect will be maintained, as well as their interest in any Profit Sharing Plan to which they may be eligible.

Said Sponsor further agrees for the Armco Company that when any of the said Members shall return from the field of action to Middletown, Ohio, in good standing, they shall be returned to the positions which they held at the time this contract was entered into, or in case that is impossible or impracticable because of length of absence and the changes incidental thereto, or their physical condition, they shall be placed in other positions of equal value and importance within the individual's abilitymto perform.

Third: Each of the undersigned for himself agrees that in the signing of these articles he assumes all of the obligations of a "Member" of the "Armco Ambulance Corps", and that he does

bind himself to serve with the American Red Cross in France for the duration of the war, or until honorably discharged by the said the American Red Cross or other proper authority, and is released by a three-fourths (3/4) vote of the members of said Corps at the time of his discharge.

He further agrees to heartily support all of the provisions of this contract and to exemplify on all occasions, no matter how trying the situation, what is known as "ARMCO SPIRIT".

Fourth: Whenever twelve (12) or more Armco men, approved by the Sponsor, shall have signed this contract said Members shall hold a meeting at the call of the Sponsor, who shall act as Chairman of said meeting. At said meeting said Members shall proceed to elect from their number a Captain of said Corps. They shall also elect from among their number a First Lieutenant, who shall act as assistant to the Captain in such capacity and with such authority as he may designate from time to time. Individuals receiving a two-thirds (2/3) vote of the membership shall be declared as elected to fill such office, and shall serve until their successors are elected.

Fifth: If at any time the Members of said Corps become dissatisfied with the conduct or the ability of the Captain of said Corps, they may, on due notice to all members, call a meeting for the purpose of electing a successor, and the Member receiving a two-thirds (2/3) vote of the active membership of the Corps who are in good standing, shall be considered Captain until his successor is elected in the manner provided.

Sixth: All funds provided by the Sponsor for the purpose of complying with the provisions of this agreement shall be forwarded to the Captain, and deposited by him in the best depository available, and disposed of in accordance with the Provisions of this agreement impartially and without favor.

Any instructions or suggestions which may be deemed advisable by the Sponsor shall be transmitted to the Corps through and by means of the Captain.

Said Captain shall furnish the Sponsor with such periodical reports as may be desired by the Sponsor and permitted by the authorities in charge of military operations.

Seventh: With full knowledge of the danger of the work undertaken and the hardships to be endured, the Member signing this contract agree to comply with the orders and instructions given them directly by the officers of the American Red Cross, and to be governed directly by the orders and instructions of their Captain in accordance with this contract, when such orders do not conflict with those of the proper officers of the American Red Cross or their representatives in the field.

Eighth: If a Member, violates any of the provisions of this contract, charges may be filed against him by any other Member, and the Captain or any two (2) Members may call a meeting of the Corps for the purpose of investigating such charges. If said charges shall be supported by a three-fourths (3/4) vote of the Members of said Corps, said Members shall be deemed expelled from said Corps and shall forfeit all rights that he may have under this contract.

Ninth: The Sponsor may at his discretion revoke the commission given the said "Armco Ambulance Corps" by the Armco Organization and supported by the company, and order its Members

to report for duty at home within any stated period. In case such an order when issued shall be nullified by action of the American Red Cross or any authorized representatives in France, then and in that event said Members shall not be held responsible for any delays so caused in carrying out the instructions of the Sponsor:

Tenth: Any person chosen to membership in the "Armco Ambulance Corps" shall sign this contract before assuming any of the duties or obligations of said Corps, and in so signing he shall be bound by all of the terms and conditions thereof.

Agreement of Individual

I hereby agree to join the "Armco Ambulance Corps" for Service in France with the American Red Cross, or with such other military agency as may take over the work of the said the American Red Cross.

I Further agree to heartily support and abide by all of the provisions of the above agreement, and the orders and instructions of its Captain.

Dated: July 19th 1917

Signed: Geo M Verity
Sponsor

Signed:
Newman Ebersole
H W Rinearson
Lee L. Hare
Victor S. Collord
Raymond D. Maneely
J R Myers
Albert P. Preyer.
William P. Pease
James E Bryan
J B Marshall
Vaughan Horner
J H Downe Ford
Sydney S. Gold
D Graeff.
Schenck Simpson
Members

"ARMCO SPIRIT"

"ARMCO SPIRIT" combines, in proper proportion, a spirit of fairness, a square deal always, both in theory and in practice; a big bread view of every problem, cutting out all narrowness and littleness; a spirit of unselfishness, of loyalty, of courtesy to and consideration for the other fellow.

"ARMCO SPIRIT" is, in fact, simply as exemplification of the highest standard of real American citizenship.

was only through pure luck that section 646 did not lose a number of men in this way.

Then followed quick moves through the forest of Villiers Cotteretts, Mont Gobert, Compeigne, Betz, Crepy, Morte Fontaine, Taille Fontaine. The work all through these days was almost incessant; but on July 18, the second battle of the Marne commenced and even more work was ready for the men as they followed the advance of the retreating Germans through Boursonne, Vouty, Corcy, Billy sur Ourcq, Chouy, St. Remy Blanzy. Through this time Section 646 worked in close connection with another section, 539, and shared with it in a citation of the order of the division in which the section flag was decorated with the Croix de Guerre and silver star, this being the fifth citation of the section.

The Allies continued their advance and from August 1st to 13th, the boys participated in the heavy fighting near Oulche le Chateau and Arcy St. Restitute, where Corp. S. H. P. Pell was severely wounded.

From August 13 until along in September the section was camped in the woods of Pierrefonds as a part of the reserve of the 10th Army. During this time the entire section was on active service at some distance from its base, and at this time Lee Ware, while bringing his car back from the front, was badly wounded during an air raid.

About the middle of September the section, after having been on the move for some time, was delighted to receive orders attaching it to a section of the division of the Marocaines, who with the Foreign Legion, were considered the most famous fighting troops of France. The division was then on its way to the Champagne sector where from the little station of Ferme Beau Sejour on September 26, the great Champagne offensive started. This was probably the most severe work that had been required of the men up to this time; and day and night they followed the retreating Germans across those desolated fields and blown bridges as they had been left by the Bosche. At the left edge of the Argonne Forest the section advanced under terrific fire through Repont and Gratenil towards Buzancy. The roads were blown to pieces and the terrible white mud made progress for the cars most difficult. For the action during these days, the section was given its sixth citation of the order of the Army, that being the Croix de Guerre with palm.

Then followed a few days rest at St. Menehould, after which the division again went into action in the region of Olizy and Grand Pre, advancing through Voux, Mouron, Termes and Olizy.

This was the last real active service of the section as the division was withdrawn a few days before the armistice in order to build up its depleted ranks, expecting to be again shot into the line on the march toward Germany. However, on November 11, the armistice was signed and active operations ceased.

The division, followed by the section, was sent southward to Belfort and Grandvillars and almost to the Swiss border, then later on moved up and took its position along the Alsacian Rhine, the section being quartered for a time at Mulhaus and Gebweiller. Here the section flag was dipped in the waters of the Rhine. The work of the section now consisted of taking care of the sick of the division.

Some changes in the personnel of the section had now taken place. Lieutenant Drake was transferred to other work, being replaced by Lieutenant B. E. Tremblay. Stewart Flagg one of the most beloved men of the section had taken sick and died of exposure while in action. Joubert, the French Mechanic, also died of exposure. N. Ebersole, suffering from an attack of appendicitis, had been placed in a French hospital.

As the weeks went on every one was anxious to get home, feeling that the work they had set out to do had been accomplished. The section moved first across the Vosges Mountains to Luneville and from there to the base camp at Ferrier. Here word was received that those who had enlisted in France might be mustered out of service on French soil if they so desired. It was decided by all the Armco men that this would be very desirable because they could then return home on board ship and enjoy more comforts as civilians than would be the case if they should travel as enlisted men. Application was finally made, and, after having been thoroughly "de-loused" several times, and sent through the "mill" at St. Aignon, the Armco men received discharge papers, were then quartered in Paris a few days until they had obtained transportation on the "New Amsterdam" which was to sail from South Hampton, England.

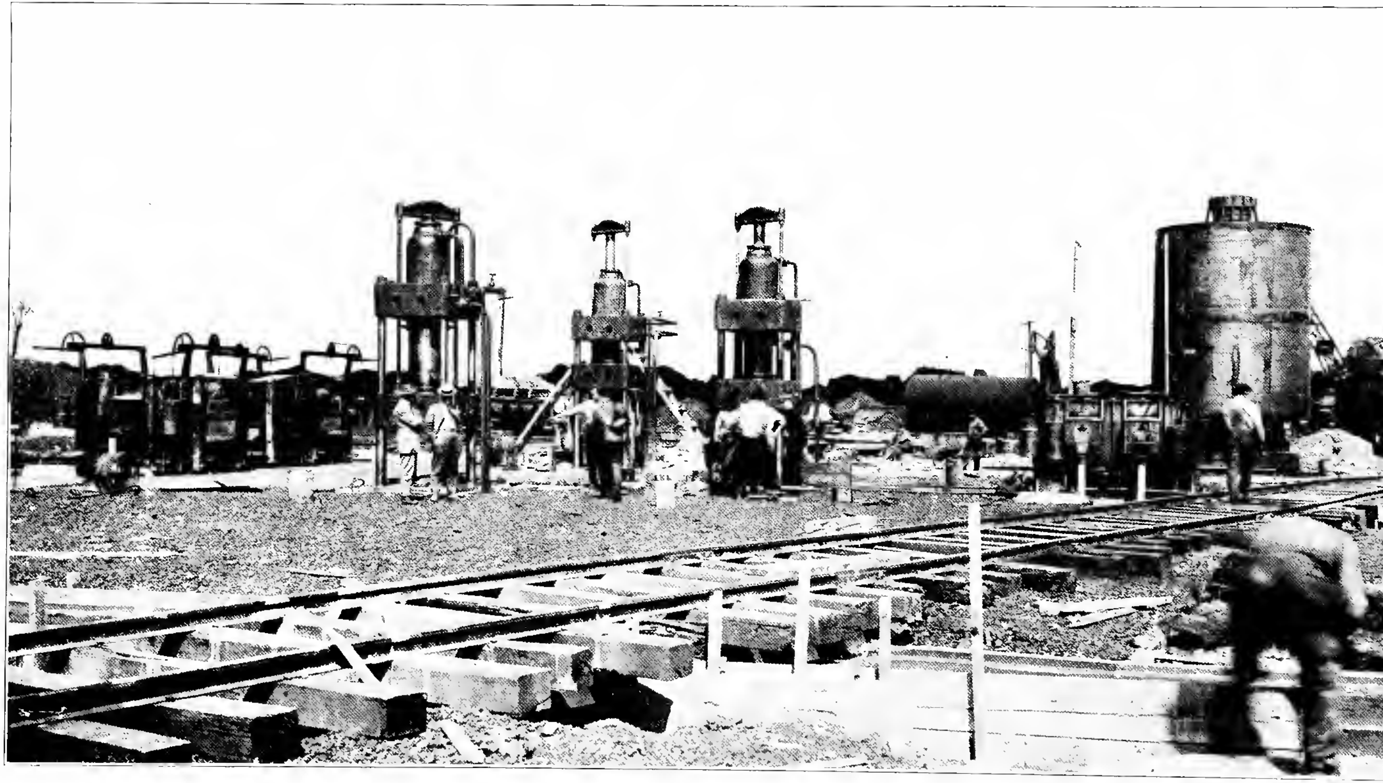
Just before leaving France however, word was received from the Headquarters of the French Army giving the sec-

tion its final award of the Fourragere in the yellow and green colors of the French Military Medal. This was indeed a great climax to the distinctions given to the section in that, although a number of other American units had by this time won a lower grade of the Fourragere, no other American section or unit had ever been given this second, or yellow and green Fourragere.

After a stay of three days in London the unit came safely to New York; landed on May 2, 1919; were gloriously met by their families and friends. The very next day, May 3, all Middletown turned out to welcome home the Armco ambulance section. When the men sprightly stepped from their special car in which they completed the last leg of their journey, they found the city in full gala attire with thousands of friends, relatives, and admirers eager to show that the community wholeheartedly appreciated the splendid services of the Armco ambulance section. Following their reception by the home folks, the men once more stepped into the ranks of civilian life; and, as far as it was possible to do so, took up their work where it had been laid aside two years before. After nearly two years the Armco Ambulance unit had again returned home feeling that it had been bound together and protected through its trials by that Armco Spirit which had inspired both the men who went with the unit and those who helped them on their way.

For action at various time during their work in France the following Armco men had been decorated individually with the Croix de Guerre:

Corporal H. W. Rinearson, Lee Ware, James Bryan, J. M. Beard, Wm. Pease, C. S. Simpson, J. B. Marshall, V. Horner, A. P. Preyer, Sergeant N. Ebersole. The honor conferred on these men, however, was to a large extent only made possible by the loyalty and devotion of their fellow workers, each of whom so well played his part in the service.



Making Shells "Out in the Open" Until a Roof Could be Put Overhead

Chapter XXV

Manufacture of Munitions for the World War

Erection of the Forge Shop—3″ Russian Shrapnel Shell Forging— Equipment of Shell Forging Shops—Russian Machined Shells—3″ Holland Shells—18 lb. British Shells—4.7″ U. S. Shells—4″ British Quick Firing High Explosive Shells—8″ and 9.2″ British Shells—Reclaiming Defective Shells—Base Adapter Forgings—6″ British Shells—155 MM. U. S. Shells—Sawing, Fracturing, and Loading 6.7″ Diameter Rounds for 155 MM. Shell Billets—Mechanical Devices for 155 MM. Shells.

THE American Rolling Mill Company secured its first contract, for one million 3″ Russian shrapnel shell forgings, on March 19, 1915. As practically no planning had taken place previous to this date, it was necessary for the engineering department to work very rapidly. Buildings had to be erected, additions made to the power house and necessary equipment purchased so that the shipments could be made on scheduled time.

On April 5 the first purchase order was issued from the engineering department covering the structural steel for the original forge shop, which was a building one hundred and eighty feet long by sixty-two and one-half feet wide with a twenty foot lean-to on the south side.

Less than one month after securing the contract, three shell furnaces were in operation, one forging hammer and part of one hydraulic press erected, tracks laid, and most of the building foundation in place.

On April 30, three presses, three furnaces and one accumulator were ready for operation, and on May 5, 1915, just forty-eight days after receipt of the contract, ten sample shells were shipped.

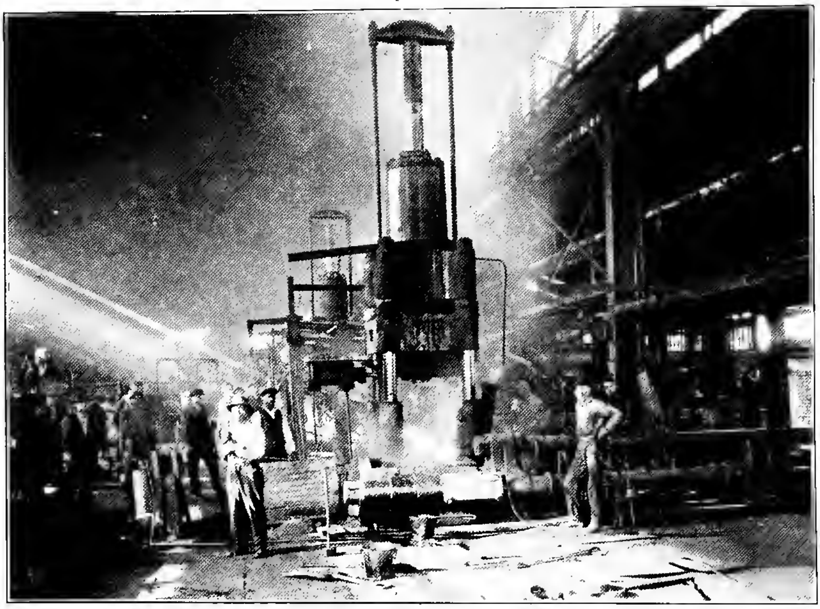
The manufacture of shells began before any of the material for the buildings was on the ground. For almost three months the crew worked without a roof over their heads, often in the rain and wearing rain coats, for the spring of 1915 was the rainiest in many years.

Most of the equipment was delivered by April 1, 1915. During the assembling and erection of the equipment, the addition of steam and motor-driven high-pressure hydraulic pumps was being made to the power plant, and it was found necessary to trench from power house to forge

shop to take care of high and low pressure water, steam and air lines for connection to accumulators, presses, etc.

While the engineering force was at work on these problems, the Armco research and inspection departments were making plans to take care of their part of the task, which covered the responsibility for rolling steel of the proper chemical composition for the inspection, chipping, heat treatment and testing of the metal; for the heat treatment of the punches, dies and other forge shop tools. It was also necessary to see that the outside inspectors, particularly the representatives of the Russian Government had all the necessary tools and material to carry on their work properly.

The first real work which was done along these lines was to make experiments and find a satisfactory method of quenching and tempering steel of the analysis specified by the Russian Government. This was necessary, as up to that time Armco had worked very little with high carbon steel; nothing could be found in printed form in any of the libraries of the vicinity, and no one was kind enough to volunteer this information. Heat treatment data, however, were obtained a short time before the forging of shells was commenced.



Unit for Making Shell Forgings

The Russian specification for machined shrapnel called for a firing test before beginning the wholesale manufacture. The choice of shells for the experimental batch was left to the factory, and a representative of the factory was permitted to witness these tests if he cared to.

This experimental batch was composed of fifty shrapnel. Twenty-five were tested by firing for accuracy and solidity, twenty-two for solidity only and three for mechanical and tensile tests.

Ten shrapnel were picked from the twenty-five that were fired for accuracy, and were loaded with black powder and detonator; each of these was placed, one at a time, in the exploding pit and fired. In this test, splitting of three shrapnel shells is allowed provided the remaining seven are all in good condition.

The American Rolling Mill points with pride to its record of 100% in these tests.

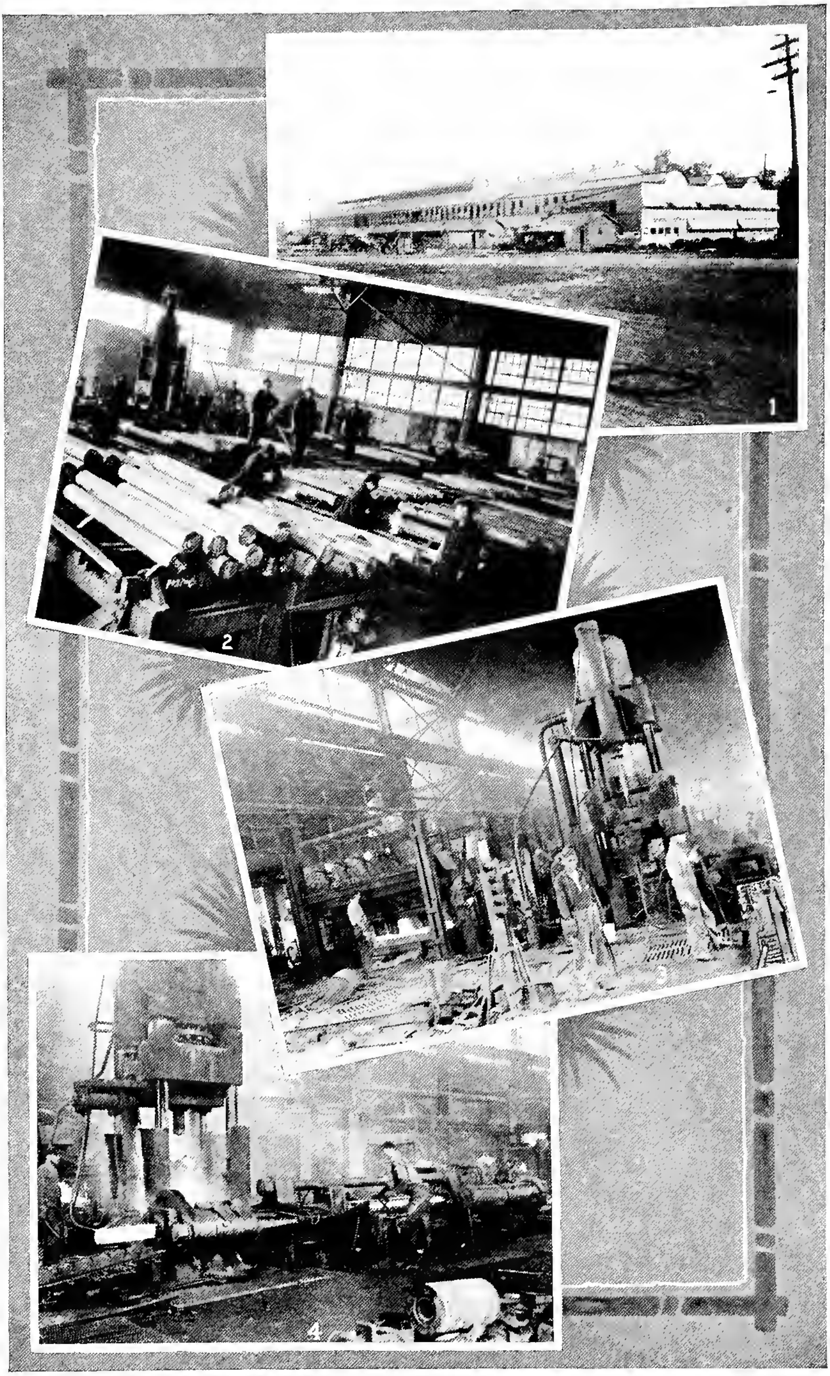
After getting well started on the Russian contract, Armco was asked to take additional contracts calling for larger shells. Late in August 1915, plans were completed to extend the original forge shop building one hundred forty feet to the west. Structural steel was ordered and delivered so that these extensions were under roof by the last of November 1915.

A building sixty feet by one hundred twelve feet running north and south and connecting to the extreme west end of the forge shop was erected in 1915. In this building the most modern equipment that could be purchased was installed for machining the various tools necessary to give the best results in the forging operations.

A constant effort was being made to find some material that would give longer life to the tools. In connection with this machine shop was a very complete heat treating department, which was equipped with submerged, car type and standard furnaces, electric oven, oil and water tempering tank, lead pots, etc.

This department received the forged punches, dies and other tools from the new blacksmith shop which was located in the west end of the shell forge shop, and was equipped with one five hundred ton press, two two thousand pound steam hammers, one eight hundred pound hammer, and one three thousand pound drop hammer.

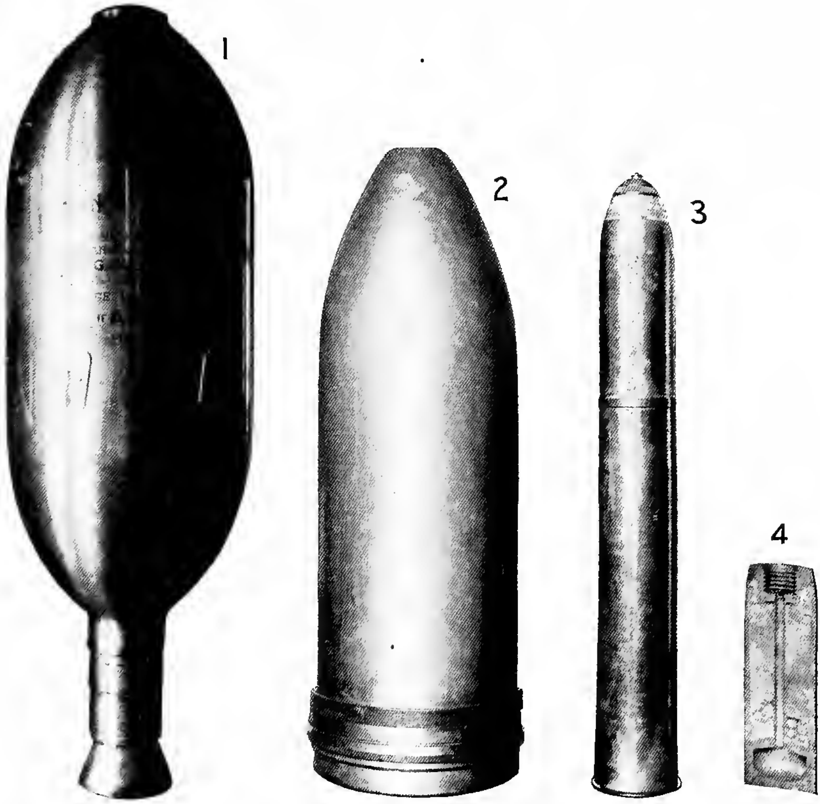
In June 1916, it was again found necessary to increase the floor space, and a forty foot extension was added to



Scenes in the Shell Forge Shop at Armco.

the eastern end of the forge shop. This was the last addition made to the main plant with the exception of several low buildings erected to house the inspection and shipping department.

The second contract received by Armco was from the government of the Netherlands calling for twenty gross tons, or about twenty-five hundred three inch high explosive shell forgings, and was known as the Holland shell. This contract was received October 25, 1915, and complete shipment made November 5, 1915.



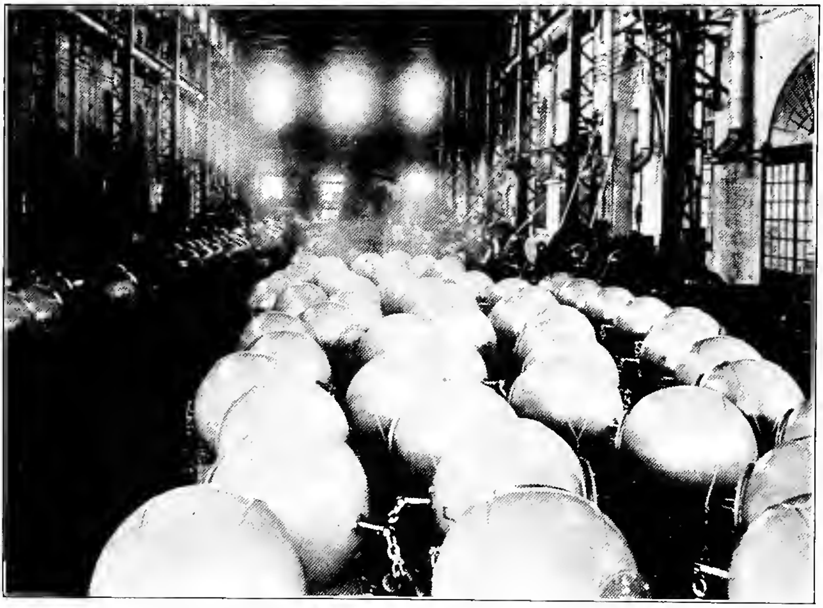
Trench Mortar Bomb and Shells

The third contract which was received on December 14, 1915, called for one hundred thousand, eighteen pounds, British shrapnel forgings. The first shipment made was December 28, 1915, and complete shipment February 12, 1916. An additional order for one hundred thousand was received January 4, 1916. The first shipment was made on January 27, 1916, and the contract completed April 1, 1916.

The fourth contract received February 14, 1916, called for three thousand 4.7″ United States shrapnel, rough machined.

As considerable difficulty was experienced in forging, complete shipment was not made until April 19, 1917.

The original forgings were made from a square billet which had been given one pass through the rolls used for 3″ Russian billets to flatten the corners. The billets were then hack sawed to length. In forging, an attempt was made to pierce the powder chamber to finished size, but was unsuccessful in obtaining a surface free from seams and other defects. It was found that more successful



Mines made of Armco Ingot Iron

forgings could be made from round slugs; so billets were swaged to 5″ rounds in the blacksmith shop and sawed to length. By reducing the size of the piercing punch, thus allowing for interior finish, the contract was completed satisfactorily.

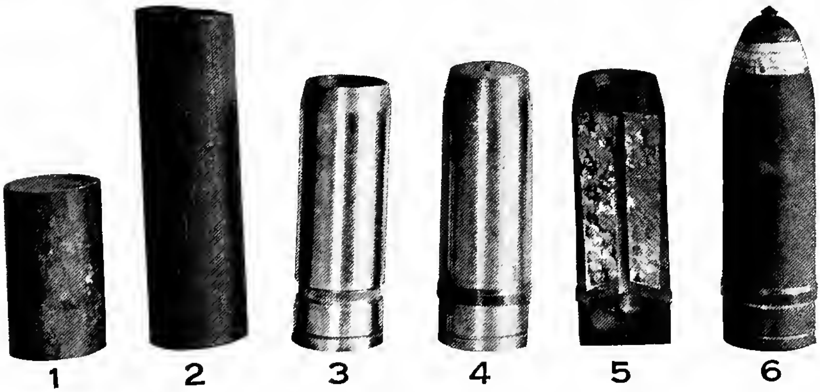
The fifth contract calling for sixty-eight thousand four inch quick-firing high-explosive shells was received from the British Government February 28, 1906, and complete shipment made June 21, 1916.

The next contract was received February 18, 1916, and called for 8″ and 9.2″ British high explosive shells. The first shipment was made one month later and final shipment was made April 1917. It was necessary to make many changes in the forge shop to handle this order, as these were the first shells to be forged nose downward, heated in continuous furnaces, and drawn horizontally. The chemical composition of the steel was about the same as used on previous orders.

Northeast of the forge shop a building was erected which was later known as the shell proving shop. This department was equipped with seven lathes and three drill presses. The 8″ and 9.2″ shells were first drilled and then a rough cut was taken on the outside. The proving operations for 6″ shells consisted of centering, rough turning, and facing ends. This department reclaimed over 85% of the shells which had been rejected by British inspectors.

At the same time that Armco secured the contract for 8″ and 9.2″ British shells, an order was received for two hundred thousand 8″ and one hundred and two thousand 9.2″ base adapter forgings. These forgings were to be used in the make-up of the completed shell. Since these shells were made with noses, a separate forging had to be supplied to form the base.

From the drawings submitted at the time the order was secured no trouble was anticipated in their manu-



Russian Shrapnel at all Stages of Manufacture

First, the inspected slug ready for forge shop furnace; second, the pierced or forged shell ready for annealing; third, the shell ready for assembling and loading department; fourth, the shrapnel fitted with Zinc screw; fifth, sectional view of shrapnel; sixth, finished product ready for firing.

facture. It was soon found, however, that the three hundred ton presses to be used were much too light to make them without many rejections. These rejections were caused by over or underweight billets, scale, cracks, and seams. With all its presses scheduled up on 8″ and 9.2″ shells, Armco worked at a great disadvantage in completing the contract. In fact, about one-fourth of the 9.2 adapter contract was sublet in order not to delay the shipment of shells which were so badly needed.

On June 1, 1916, an order was received for fifty thousand 6″ British Howitzer Mark III shells. This was the largest shell Armco had attempted to make on the smaller presses up to this time, and due to the weight of the billets, mechanical devices had to be installed, so that it was not until July 8, that the first shipment was made. Additional orders for three hundred and five thousand on June 19, 1916; three hundred thousand on September 6, 1916; and four thousand on March 22, 1917, were received, making a total of six hundred and fifty-nine thousand shells of this size. The last order was completed on August 4, 1917.

As soon as the United States entered the war, it seemed certain that Armco would receive further orders for shells; consequently as many as possible of the old shell organization were located, so that they could be collected in a short time. It was not until November 9, 1917, however, that an order for shells was received. This initial order called for five hundred thousand shells to fit the 155 MM French guns, and was received direct from the United States Government. This shell more than any shell Armco had previously made was like the 6″ British shell, being approximately the same diameter although several inches longer. The increased length made it impossible to draw this shell on the old vertical draw presses. At that time it was practically impossible to buy hydraulic presses of any kind, so the company decided to cut the two long stroke horizontal draw presses in two, and make enough additional parts in their own plant to make four horizontal draw presses of sufficient stroke.

On the one hundred and fifty-five MM shells many new mechanical labor saving devices were perfected.

A shed, with a light overhead crane on which was hung a trolley and air cylinder, was built over the place at which the cars of billets were to be unloaded. On the end of the air cylinder piston rod a pair of tongs was fastened. The

unloader placed the tongs on a billet anywhere in the car, picked it up by running air into the cylinder by means of a valve clamped on the end of the tongs. With slight exertion the carriage and trolley could be moved so the billet could be placed on a vertical conveyor, also operated by an air cylinder. This vertical conveyor raised the billet to the top of a gravity conveyor which carried it to the charging platform where it rolled off on the racks at the end of the furnace. Workmen kept the billets straight and fed them into the furnace.

After passing through the continuous furnace, the billets rolled down a fore plate on the scaling machine, which was a motor driven machine extending across the entire width of the furnace, with two corrugated rolls turning in opposite directions, on which the billet "rode" until it was entirely scaled, after which it was pulled off by a light hook to another gravity conveyor. This conveyor brought the billet to the "billet tilter," a rotating arm with a hopper on one end, which by operation of air cylinders, raised the billet over the forming die and allowed it to fall into the die.

Bolted and dowelled to the moving platen of the press was a sliding punch holder operated by air into which were screwed the upsetting and piercing punches.

When the billet tilter dropped back after putting the billet into the die, the press was operated with the upsetting punch over the die, and pressure left on until the press was stalled. During the upsetting operation the piercing punch lowered into a cooling tank alongside the die housing. Pressure was then reversed long enough to raise the moving platen sufficiently high for the piercing punch to clear the die. The piercing punch was then slid over the die while the oiler dumped a spoonful of fine coal in the center of the billet to lubricate the punch, and the press was operated downward until the moving platen hit the stops. The press was again reversed, and, just as the piercing punch cleared the mouth of the shell, the hydraulic ejector cylinder was operated, shoving the shell out of the die, while at the same time the piercing punch was slid back out of the way leaving the press ready for another billet as soon as the die was blown out and oiled.

As the shell rose from the piercing die, the draw press operator placed a hook around it and pulled it over an apron into the draw press. By means of a tilting air pipe,

he blew out the burnt coal and scale from the interior of the shell and then operated the draw press, sending the shell through the drawing dies. On the end of the draw press was an automatic stripper of door design, which was pushed up by the shell and dropped down on the punch when the end of the shell was reached. When the press was reversed, this door removed the shell from the punch and the shell dropped on a short gravity conveyor which ran to the stencil machine.

This machine was a jaw riveter, mounted vertically over the center of the conveyor, into which had been placed a special head containing specially made stencils for stamping heat number, steel code, forging code, and squad boss number.

After the shell was stamped, the set-up man pulled a lever which threw the shell off the conveyor, and it rolled over to the hot-inspector. The inspector tried the length gage to determine proper base thickness and length while the shell lay on the floor, and then the set-up man stood it up on the closed end by means of a pipe. The inspector then inspected the shell for eccentricity, straightness and bore. While the inspector "rang up" on the proper register what defect the shell possessed, if any, the set-up man knocked the shell over and gave it a shove into a gravity conveyor a few inches below the floor level which ran outside the building on the south side, across the track to a vertical conveyor in the inspection shed. The vertical conveyor was a motor driven endless chain type, with special arms for carrying the shells. It delivered the shells to another gravity conveyor, starting about five feet above the ground level and running about eight feet from the vertical conveyor. Here the shells fell on the ground and were rolled and piled at the proper place by men with shell rollers.

The shells from each heat and from each turn were piled separately, allowed to cool, and then were taken to the cold inspection mandrel by heats, where they were given their final inspection. After inspection, they were stamped with the government inspector's OK and rolled on the ground to the railroad track where they were lifted on hooks, five at a time, by an air cylinder, hung on a trolley and swinging boom, and piled in the car ready for shipment. No annealing or heat treatment was given these shells by Armco.

The first shipment of six hundred and sixty shells was made on February 14, 1918, and the order was completed December 27 of the same year. In the meantime a second order was received September 12 for one hundred thousand, and a third order for seven hundred and fifty thousand was received on October 4. The second order was completed December 31, 1918. On that date Armco had made one hundred and forty-two thousand eight hundred and eighty-two shells on the third order, making a total of seven hundred and forty-two thousand, eight hundred and eighty-two shells in ten and one-half months with the entire equipment working only a small percentage of the time.

In the fall of 1918 the influenza which was sweeping over the country began to make great inroads upon the force at the forge shop. Because of the shortage of men it was sometimes necessary for men to work as long as sixty hours at a stretch. Finally, General Williams of the Ordnance Department sent out a telegram to the munition plants stating that production was falling off and making a plea for more shells. In that month there were twenty-four deaths in the forge shop, but in spite of this disruption of the working force the shop broke its monthly production record.

Until about November 1, 1918, the only thought had been the greatest possible production and the making of equipment for two additional units had already been started. About the first of November the prospects of an armistice began to be considered seriously and the matter of additional equipment was dropped. Shortly after the armistice was signed Armco was given assurance that the forge shop would be permitted to run until the following spring in order to provide for the government in any emergency and also to allow time for readjustment to a peace basis. This advice was quickly followed by instructions to begin immediately curtailing production and cease operations entirely not later than December 31, which instructions were accordingly carried out.

The record of the forge shop will always be one to fill the heart of every Armco man with pride, for the company had a record not equalled by any other shell forging plant in the United States. Each month the company was asked for promises of shipments for the succeeding month, and up to November each promise was

for a very considerable increase over the amount for the preceding month. Armco was the only company making shells in the United States to meet its full promises. Armco did not fail on a single month's promise in spite of the many handicaps under which the shop was operated. While the record for delivery was not approached by any other concern, eagerness to produce in quantity did not lower the Armco standard of quality, for in the final government tests Armco had the lowest percentage of rejections of any concern in the United States. The final record for rejections was 0.3%, the closest rival running 0.6%. In addition to shells having the highest record in the rigid government tests, letters came from the various machining companies to which they were sent, stating they preferred Armco shells above those made by any other company due to the fact that they were more uniform in every respect.

For the cause of civilization Armco made in all more than three and a quarter million shell forgings. The production of this quantity of shells with the small percentage of rejections which attended their manufacture by an organization working at times without a roof over its head, and always facing severe mechanical obstacles, is an achievement worthy of the high cause for which it was done.

Total production of shells manufactured and shipped during the war by Armco:

114,300—3	"Russian Shrapnel (Machined)	770 Net Tons
1,001,559—3	" Russian Shrapnel forgings...	5642 Net Tons
2,500—3	" Holland High Explosive Forgings....................	22.8 Net Tons
201,995—18#	British Shrapnel Forgings ...	1994 Net Tons
3,000—4.7"	United States Shrapnel (Rough machined)........	60 Net Tons
68,000—4	" British Quick Firing High Explosive forgings..........	1475 Net Tons
44,600—8	" British High Explosive Shell Forgings................	5992.5 Net Tons
114,228—9.2"	High Explosive Shell Forgings	20392 Net Tons
200,000—8	" British Base Adapter Forgings....................	3025 Net Tons
102,000—9.2"	British Base Adapter Forgings....................	2575 Net Tons
659,000—6	" British Howitzer Mark III Shell Forgings...........	46460 Net Tons
742,882—155M.M.	United States Shell Forgings....................	56459 Net Tons

Chapter XXVI

Armco Organization

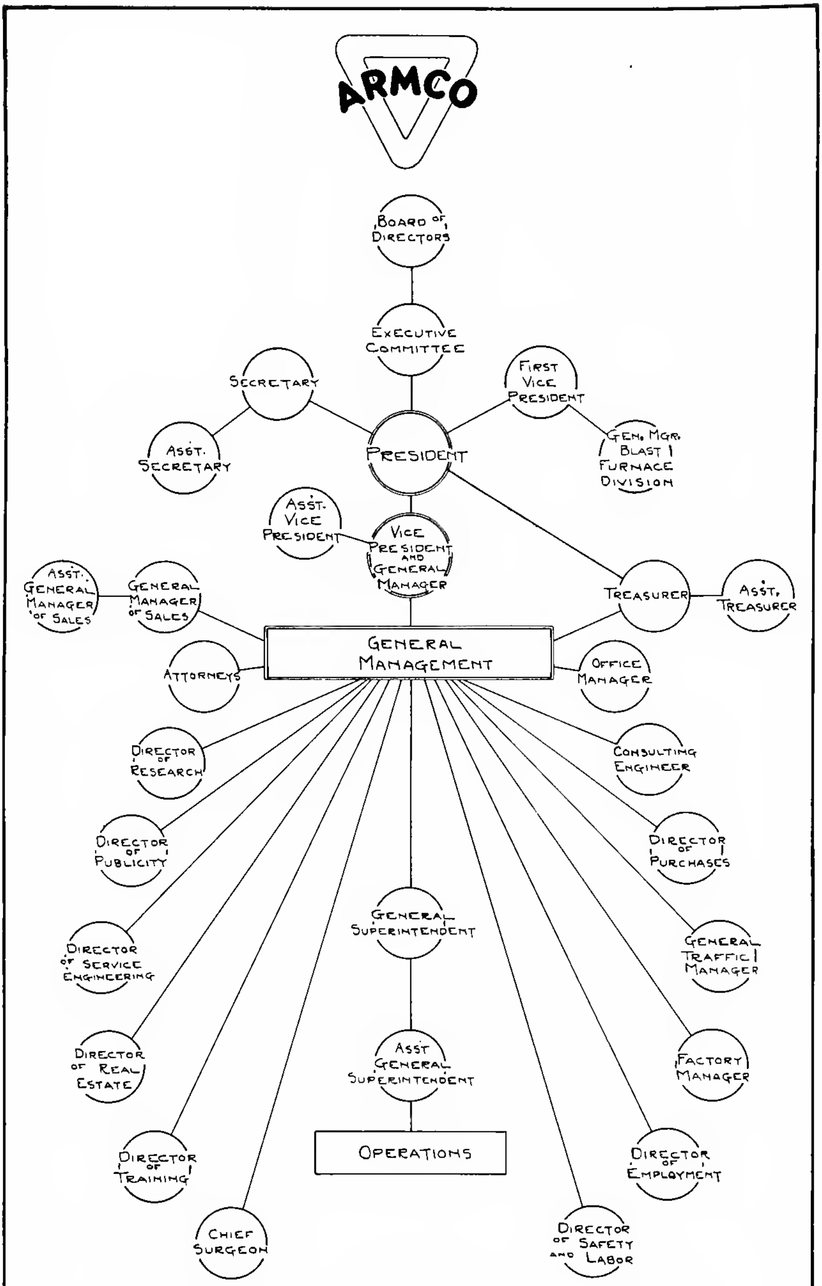
The Hub, the Spokes and the Rim of Armco—First Line—Emergency Committee—Foremen's Forum—Departmental Advisory Committee—General Advisory Committee.

INDUSTRIAL Democracy is a term given to a formal sort of organization whereby representatives of the management and employees enjoy friendly relationship. Organization of this nature has become necessary in most plants to hold the personal contact between the employer and men such as existed in the days when manufacturing was done in small shops instead of in mills employing thousands of men.

Armco has been in the forefront in the development of practical industrial democracy. From the very beginning of the organization, Armco has never permitted itself to lose personal touch with its men, but through personal contact has always endeavored to secure the confidence, respect and good will of its workers. The interests of the men in the plant and of the company have been held as mutual, and on this basis a spirit of loyalty and cooperation has been built which has reached its fullest development in what is known as "Armco Spirit."

Just as the hub of the wheel transmits its power and motion through strong and reliable spokes to the rim where the real work is done, Armco transmits the spirit and ideals of the management through radiating "spokes" to the many men and women composing the Armco organization as a whole.

The Armco organization wheel has the active executive officers as its hub. The spokes are composed of the main heads of divisions and comprise a group and designated as "First Line" men. A gold ring with the company's insignia as a seal is worn by this group as a visualization of the close cooperation that exists between them, and of their large responsibility in passing on to the general organization the plans, policies and ideals of the company.



— ADMINISTRATIVE ORGANIZATION OUTLINE —

The inner rim of the wheel is the "Foreman's Forum" and the outer rim, which makes up the last and largest circle, is The General Advisory Committee.

The Foremen's Forum meets once a month for the exchange of opinions, the charting of operations, the study of company policies, and a thorough understanding of the human element in business as it should be known by these men who represent the management on the job.

The General Advisory Committee represents each group in the organization. In 1920 there were fifty-seven of these committees with a total membership of one hundred and fifty-three men who are elected annually by secret ballot. Every employee who has been in the continuous service of the company for one year is entitled to vote and is eligible for election.

The General Advisory Committee is made up of smaller departmental advisory committees which represent to the management in an advisory capacity, the employees of the respective departments. It is the committee's privilege and duty to take up with the department superintendent any matter which in their opinion is not being handled properly. It may be a question of production or a personal matter. The superintendents may likewise call upon the committees for advice or first-hand information which they should have. These departmental committees meet whenever need for their action and service arises.

Once each month all of the departmental committees meet as a General Advisory Committee under the chairmanship of the general manager. This larger committee holds the same relation to the general management that the departmental committee does to the department. Its functions are to advise and learn the policies of the general management, to convey to the employees an understanding of these policies, and to reflect the sentiment of the employees on such matters as may be of help to the general management. The committees have no administrative, legislative, or executive functions.

An Emergency Committee was organized to aid in carrying on the Middletown hospital drive in 1916 and then was retained as a permanent organization to act whenever The American Rolling Mill Company as a company chooses to put itself behind a public welfare campaign. The Red Cross, Liberty Loan, and Civic Fund were all carried on successfully in the plant by the Emergency Committee.

This committee is composed of division heads, department heads, and their principal assistants.

Since 1904 the men of the sheet and jobbing mill department have elected a committee from their own membership whom the management has called in for advice and consultation and who could in turn present matters of mutual interest to the management. In 1918 similar groups known as War Service Committees were chosen from the employees in all departments. These rendered a signal service in keeping the wheels of industry running smoothly during the trying days of the war.

By these radiating circles of influence and counsel The American Rolling Mill Company has succeeded throughout its growth from a small plant to a great corporation, in keeping, between management and men that personal contact without which progress and prosperity are not possible. This personal contact has resulted in industrial peace and the co-operation of all members of the organization in the development of the Armco plants and of Armco products.

Chapter XXVII

ARMCO Traffic Department

Its Organization and Functions—Difficulties Encountered to Keep Supply of Raw Materials Coming in in Order to Keep the Plant Running.

THE expansion of any industry inevitably calls for an expansion of its Traffic Department, which has charge of the movement of all raw materials into the plant and finished products out of the plant. This is especially true of an iron and steel works, where large tonnages are involved. For the first few years of Armco history the details of the in-going and out-going freight were under the direct charge of the general manager. As the volume of the business grew the movement of the vast amount of material that entered into the manufacture of Armco products became a matter of increasing importance.

It was not until 1910, however, when Armco built the East Side Works and entered the field of big mill practice, that a full fledged Traffic Department, reporting to the general manager, was organized. At this time the freight business of the company comprised about three hundred carloads each month. During 1920, ten years later, the volume of freight at the Middletown plant numbered more than three thousand cars each month, which gives some idea of the tremendous amount of work that falls on the department whose duty it is to see that this freight moves in and out without delay or disturbance.

Armco was not alone in this new idea of a separate and distinct traffic department. Industry generally was adopting it as the problem of traffic became more and more complex. It became apparent that someone should be assigned the duty of keeping in touch with the requirements, not only of the law governing transportation, but with all the conditions brought about by its application in the matter of rate adjustment and special services.

Ten people today comprise the Traffic Department of Armco, consisting of a manager, assistant manager,

and eight clerks. This force is supplemented from time to time temporarily by the loan of men from other departments as emergencies may demand. The Traffic managers and their assistants are responsible for the proper interpretation and application of the traffic and transportation law, classifications, rate adjustments, shipping practices and all other information that has to do with the transportation of raw materials and finished goods in and out of the plant.

The details of the work are divided into seven subdivisions, each one of which is operated as a separate unit with special tasks assigned. These divisions include car supply, tracing and embargoes, demurrage, rates and classifications outbound, rates and classifications inbound, together with the auditing of freight bills and the handling of overcharge and loss and damage claims. Inbound freight, car records, and weight and tonnage abstracts are also carefully recorded.

The Armco Traffic Department also has charge of export shipping, with all its complicated and exacting rules and regulations. This includes contracting for steamer space, securing railway and other necessary permits, supervision over and preparation of necessary shipping documents, issuance of insurance papers, and the compiling of all documents in bankable form for the use of the treasury department. If the goods are lost enroute the handling of the claims against insurance companies for losses from warehouse or marine causes or other details, is under the charge of the traffic department. For the reason that errors in handling documents in export business often result in heavy fines or other serious losses, it can be seen that this division has many added responsibilities which call for alertness and wide experience in foreign tariffs.

One of the widest fields for service to the company lies in the work of handling the car supply, tracing goods shipped, and weathering the embargoes. These handicaps to industry were especially serious during the period of the World War and the situation was so acute at times that the entire Traffic Department organization was out in the field "riding cars" to keep the plant in operation. This was especially true during the coal strike when the plant was operated on fuel oil. The situation was so serious at one time that not only all the members of the

traffic department were on the road but a very large part of the sales department was requisitioned by the traffic department to "ride" the cars to keep the wheels of industry turning at Middletown.

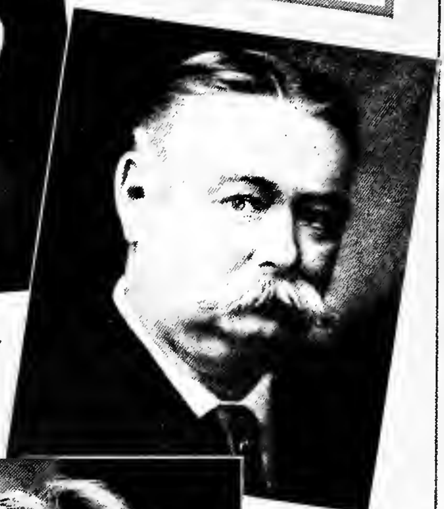
Some idea of the extent of the traffic of Armco each month is evidenced by the fact that at the end of its first twenty years, the freight bills at the Middletown plant when operating normally amount to approximately two hundred thousand dollars a month. This does not include the other plants located at Columbus, Zanesville, and elsewhere, which would considerably increase this total. Each of these bills must be properly audited as to rates and extension, classification and weight billed, and be closely checked to avoid error. Such matters as the filing of claims for overcharges, loss and damage, requiring intimate knowledge of rates, classification and rules governing proper application and the legal methods of handling such matters, are daily problems of the traffic department.

The various departments of the plant are kept in touch with materials enroute by the traffic department and records are kept covering all shipments coming into the plant. Each individual car is followed from its starting point to its final unloading, in order that there shall be no guess work as to the time of the receipt of the raw material.

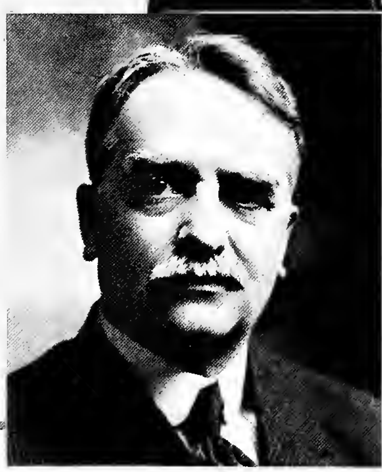
In addition to handling the freight movements at Armco, the traffic department is also able to render a valuable personal service to the business offices, in securing tickets, sleeper reservations and other conveniences connected with traveling, which saves much time, trouble and expense.

The work of the traffic department under normal conditions is not spectacular. Transportation is however the artery of business, through which the necessary supply of raw materials and finished products flow. It is appreciated most when it is realized that the clogging of a single vein, insignificant in itself, may mean the shut-down of a great plant.

GEO. M. VERITY - *Pres.*



W. T. SIMPSON
First Vice Pres.



R. C. PHILLIPS - *Secy.*

THE FOUNDERS AND FIRST OFFICERS OF
THE AMERICAN ROLLING MILL CO.

Chapter XXVIII

The Purchasing Department

The Organization of a Purchasing Department—Difficulties Encountered During War Period—Growth in Volume of Purchases.

BACK in 1901, at the very beginning of things at ARMCO, there was no purchasing department. Among the varied duties of the then president-treasurer and general manager was that of buying all things needful for the operation and maintenance of the plant. To be sure, there was only one little 30-ton open hearth furnace to be fed, four sheet mills, a galvanizing shop and factory, and fewer men to break up things that must be repaired. Nevertheless, at that time it seemed to be a great big job, and when we consider it in connection with all else that was to be done in the foundation building of a great industry, it was a real task.

There is in existence today a certain small red book in which is recorded in the president's own handwriting the first purchases of scrap and various other supplies.

By 1903 the open hearth department consisted of three furnaces and, of course, the work of buying increased accordingly. In April of that year, the president and general manager indulged in the luxury of a private secretary and assistant. For a time after the new secretary-assistant's arrival, the purchases were still handled in the same old way, the orders all being written out in longhand.

Gradually, however, the work of placing some of the local orders was passed on to the president's secretary, and with his aid and that of a typewriter, orders were for the first time made out on a machine; perhaps at this time we find the first signs of life of the real purchasing department of the future. An order book was established, and in it purchases were recorded and a permanent record made.

With the advent of the Zanesville mill in 1905, additional duties came to the purchaser and the president's

secretary was then given the title of assistant purchasing Agent, although there was no other purchasing agent at that time.

In 1909 the real position of purchasing agent was first created and the secretary advanced to that position. The old washroom on the first floor of the original office building was removed and in its place a separate room was for the first time set aside as the headquarters of the purchasing department.

The building and equipping of the new East Side Works in 1911, gave the purchasing department its first real big work. There was a great deal of new equipment to be ordered and the purchasing agent and his assistant, working in connection with the engineers in charge of plant specifications, received a splendid training in the art of big buying.

At the same time important changes were made in the character and manner of handling the work of the department. A branch office was maintained in Detroit in order to be near the great scrap center of the country. At that time the purchasing department took over supervision of all mill supply stores which had formerly been reporting to the treasury department. The stores continued under their management until 1918, at which time they were transferred to the operating department.

The work in the plant had now changed from small to large mill practice and, with the substantial development of all producing departments, the responsibilities of the purchasing department increased proportionately.

In 1913 a representative of the purchasing department was sent to Europe to investigate the source of supply of certain materials, such as ferro silicon, ferro manganese, magnesite, aluminum and other alloys and minerals used in the manufacture of Armco products. His report, made jointly to the purchasing and research Departments, covered nearly six months' work in Norway, Sweden, Denmark, Germany, Austria, Switzerland, France, and England.

Things now began to move swiftly and called for much study and planning by the department, for with the breaking out of the great World War in 1914, the supply of some necessary raw materials was entirely cut off and new sources had to be found immediately.

Those were unprecedented times, and every move was most carefully watched. Austrian magnesite, Eng-

lish ferro manganese and Norwegian ferro silicon could no longer be imported and could only be bought from the fast shrinking stocks held in America. By that time Armco began to figure on war orders, and new equipment, and all types of supplies were needed.

By 1917, with the entry of America into the World War, the quantity and variety of articles purchased had increased incredibly. Prices were mounting skyward, and it was no longer a case of getting an article for the best price, but to get it at any cost, provided quick delivery could be assured.

The personnel and the work of the department during this strenuous war period naturally varied greatly due to the uncertain conditions that were to be met. At one time the personnel of the department consisted of 13 members, this being about double of what is normally required.

During the war period, as the requirements of the mill increased rapidly, the work of the Purchasing Department was doubled many times over. The nature of purchasing is, however, such that if centralized and handled in an efficient manner, a very large amount of work can be taken care of without materially changing the organization itself. To give some idea of the quantity of work that passed through regular channels, it is interesting to know that some 30,000 tons of coal had to be purchased or produced from the company's mines for each month's requirements. Scrap iron purchases amounted in value to some $75,000 per month; spelter six thousand tons per year. In all, there was carried by our store department an inventory of about twenty thousand items.

A record has been kept of the number of salesmen that are interviewed by the various members of the purchasing department. The greatest number during any one month was 260, the average being somewhat below this, or about 210.

Methods of handling the detail of the work of the department in the placing of orders, recording of prices, keeping in touch with and watching the markets, and following the long swing of the price curves in order to buy to the best advantage, these are the things in which tremendous advancement has been shown in the last twenty years.

What the story in the next twenty years will be we do not know, but with the steady expansion of our company at home and the acquisition of auxiliary plants in other cities, the purchasing department has a great field for work and service before it. Plans are now in the making covering a further centralization and standardization of purchasing through headquarters at Middletown, to obtain a more effective use of the purchasing power of the company.

Chapter XXIX

The Growth of the Treasury Department

The Organization of a Treasury Department—The Installation of a Cost Department—Stores Accounting Department—The Development of the Credit Department.

DURING the first five years of the company's history the functions of the president, treasurer, general manager, and purchasing agent were all combined in one person.

When the first pay check was issued in Middletown there was no regular treasury department as such. All work of that kind was taken care of by the company's single bookkeeper under the direction and supervision of the president, who handled all the financial affairs of the company. In this respect the company was no different from many other small growing concerns.

It was not until 1905 that the company's accounting and financial interests had assumed sufficient importance to justify the creation of a distinct department.

By 1910 the demands of a rapidly growing business made it necessary to separate the different functions of the treasury and accounting department into sub-departments, thus creating a division.

The work of the timekeeping department, on which the pay rolls of the business are based, had originally been carried on under the supervision of a timekeeper's clerk. In the creation of a treasury division the timekeeping department was put under its jurisdiction and it has ever since that time been conducted in close co-operation with the accounting department. The timekeeping records are very interesting, showing as they do the advancement of the different men in the employ of the company. They show that some of the men who began at the bottom of the ladder are today occupying high executive positions. This department grew from one man in the very beginning to thirty or thirty-five men during the war period. During that period of development many changes in method of working were made.

A substitution of calculating machines for the pencil in the figuring of tonnage rates and wages, enabled all such work to be done more quickly and accurately.

During this period the company's pay rolls grew from twenty thousand up to a full million dollars per month. This gives a very clear visualization of the growth of Armco and of the importance of the timekeeping department of the treasury division.

The accounting department of the treasury and accounting division originally consisted of one bookkeeper, who is still on the job and is one of the oldest employees of the company. In the beginning the books of the company consisted of about one ledger and two journals. At the end of twenty years nine men were required and with the use of the most modern labor-saving machinery they were able to handle about seventy times the amount of business that was originally handled by one man.

When the order and billing section was first organized it was made a part of the treasury division. It was later placed under the supervision of the sales division in order to provide a better coordination of the work of the two functions.

The stores accounting department, originally in charge of one individual, was established to keep records of all purchases and to have a supervisory control of all of the miscellaneous supplies of the plant. This function finally grew into such proportions that it was again redivided into a stores department under the operating division and the stores accounting department, which was continued under the treasury division as a record department of purchases.

Probably one of the most important functions of the entire organization is carried on in the credit department, which has to do with the granting of credit to customers. In the early days this responsibility was entirely in the hands of one man, who judged credits through a personal visit or from personal knowledge of the customer. This method was obviously impossible as the business grew to greater proportions. It finally became necessary to organize a more modern credit department, that could work along the most improved lines. The department now consists of five individuals especially trained in credit work. Through the efforts of the credit department,

Armco's losses have remained very small, averaging not more than one-twentieth of one percent of sales.

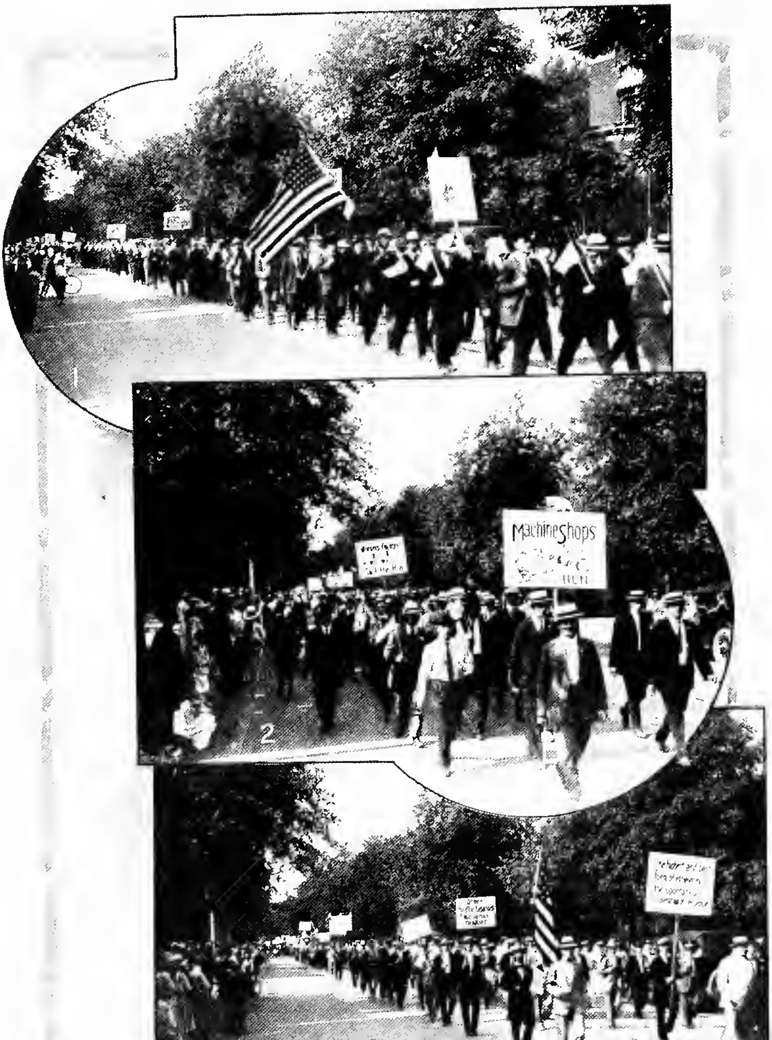
The Manager of the credit department often visits customers and assists them in the reorganizing of their own financing to enable them to meet new conditions. In this way Armco has saved many good accounts and the service rendered has been greatly appreciated. This special service is somewhat unusual in big industries but it has made the company many friends and has proved very satisfactory to all concerned.

The cost department, which is under the treasury division, was originally handled by one man and even then the work did not absorb all of his time. Modern industry has, however, come to see the light and today cost accounting is one of the most important departments of the treasury division. Accurate detailed cost accounting is especially important in an iron and steel works, where there are so many things entering into the manufacture of a finished product through which money could be lost without any real knowledge of it unless a very close check was kept at every point.

For instance when a ton of raw material is put into an open hearth furnace for melting and refining, there is necessarily a certain waste loss and it falls upon the cost department to know where every pound of waste has gone during that operation. In the old days that information was obtained by estimate, but today it is all a matter of accurate record and knowledge.

The treasury and accounting division is the real record-keeping department of the company. It is the medium through which all money comes into the company and the channel through which all money is paid out on proper order or requisition. Practically every function is so tied into its operations that it becomes the real heart of the business.

The treasury division is not only the HEART of an industrial organization, but it must also furnish the Life Blood in the shape of money, real money, to meet the pay rolls of all departments, to pay bills created by the durchasing department, and to meet appropriations made and dividends declared by directors.



"Win the War" Parade, Labor Day, 1918

Chapter XXX

ARMCO in Civic Affairs

Influence Upon the Community Life—Flood of 1913—Booker T. Washington School—War Drives—Civic Fund—Playgrounds—City Park.

A CORPORATION is a legal person and as such has most of the duties and privileges of citizenship. Its progress and prosperity, like that of the individual, are bound up with that of the community in which it is located. As a prominent citizen in its community, The American Rolling Mill Company has always recognized its duty to take an active part in civic affairs, and has tried in every way to meet its obligation and responsibility as a citizen.

In 1909 when the board of directors was debating where to locate the new plant which they were planning, the president of the company laid before the business men's association, which grew into a chamber of commerce, the plans and specifications for a greater Middletown. For the company was not willing to locate its new plant in Middletown unless the city could be made a good place for its ever increasing number of workers to live.

In the years which followed, The American Rolling Mill Company working with the other manufacturers and business men of the city contributed its influence, its organization, and its financial support for the accomplishment of this program. A public library was built, a hospital erected on a hill over-looking the city, parks and playgrounds were opened, a Y. M. C. A. and a Y. W. C. A. were established, efficient city government was secured, and the public school system was expanded as rapidly as the finances in the city would permit. In all these changes The American Rolling Mill Company played its part as a big-hearted, public spirited citizen.

In 1913 the Miami river rose in a flood which covered the business section of the town to the depth of six feet. When the waters subsided they left ruin and desolation in their wake. Transportation facilities were cut off,

people were homeless, without a change of clothing and in a large number of cases without food. The mud and rubbish, which the flood had left in the homes and on the streets, formed a serious menace to the health of the people. Although itself a heavy sufferer because the Central Works had been under water, The American Rolling Mill Company came to the aid of the city, supplied labor and teams and operated a complete railroad train on the main street of the city for cleaning the streets and carting away the water-soaked, disease-ridden rubbish, brought in food supplies, helped to police the city during the period of disorder. To its timely and efficient action was due Middletown's rapid recovery from the ravages of the flood.

The financial resources of the city did not expand with its increasing obligations, so from time to time Armco provided certain civic betterments and then turned them over to the city for operation when the city became able to undertake their management and support. The first of these civic improvements to be built by Armco was the Booker T. Washington School, which was built at a cost of $70,000 and turned over to the public school board for administration.

During the World War the Armco organization, as a whole, devoted a great deal of time to the conduct of the Liberty Loan, Red Cross, Y. M. C. A., and kindred drives. Not only did Armco men and women give liberally of their money, but they took an important part in the organization of the campaigns and the actual work of solicitation.

On January 20, 1920, the president of The American Rolling Mill Company again addressed the business men of the city, now organized into a vigorous and efficient chamber of commerce. In this address he reviewed the progress which had been made in the ten years which had past since Middletown had started on its way to future greatness. He pointed out the growing needs of the city, the need of an enlarged Y. M. C. A., and a building for the Y. W. C. A., the over crowding of the schools, the financial embarrassment of the city government, the need of parks and playgrounds, the inadequacy of the hospital to care for the needs of the rapidly growing city. And to meet these needs he proposed that a great civic fund of $1,000,000 be raised to bring Middletown into first place among the progressive cities of Ohio.

The city caught the vision and in a short campaign ending in March 1920, raised the million dollars for civic improvement. The whole city co-operated. Every family and every institution did its full part by giving what it could. Armco employees supported the campaign to the limit of their ability. The civic fund was placed under the control of fifteen representative citizens, and its disbursement was apportioned over the succeeding five years.

For several years Armco maintained playgrounds for the benefit of the children of Armco employees, and the other children of the neighborhoods in which these playgrounds were located. The creation of the civic fund made it possible for the city to administer these playgrounds in a general recreation system, and they were thereupon turned over to the city in the summer of 1921.

In July 1921 The American Rolling Mill Company opened a beautiful four hundred acre tract of woodland and meadow to the public for use as a park and great outdoor playground. The company announced that as soon as the city was able to develop and support it the park would be turned over to the city. In the meantime Armco undertook the necessary work of immediate improvement. Roads were built, picnic camps were laid out, trails cut through, shelter houses built, signs posted, and the entire park enclosed by a high wire fence.

In the center of the park, "Wildwood Camp," a permanent structure was built on what was designated as "Wildwood Heights." This camp graces the highest knoll in the woods and the trees and the foliage were trimmed away to give a beautiful view of the blue streaked western hills across the Miami valley. A rustic dining hall with a capacity for fifty or sixty people, a recreation hall with a fireplace, and a porch overlooking a beautiful valley, and five tents on elevated platforms were erected in this camp, which is fenced off from the rest of the park. At the foot of the hill below the camp a large concrete swimming pool was built beneath forest trees which make the pool shady, cool, and inviting on hot summer days. This camp was immediately used by the Girl Scouts for their summer camp, and has since been in demand by various organizations.

Until such time as the city is capable of taking it over, Armco is policing the park, maintaining it, and seeing that no vandalism, either thoughtless or otherwise, shall destroy

the many old, beautiful trees, or mar this public playground for the people of Middletown.

While Armco has contributed what it could in material things, the greatest contribution is represented in the undivided effort of its officers and a very large proportion of its working organization, in anything that has had to do with the city's civic progress. In this they are giving practical expression of their "Armco Spirit," one phase of which is defined as being "simply an exemplification of the highest standard of real American citizenship."

Chapter XXXI

ARMCO'S Pioneer Metallurgist

A Tribute to Robert Brown Carnahan, Jr.

OUTSIDE the little group who came to Middletown from Cincinnati in 1900, Robert B. Carnahan, later Vice-President, was the first member of the new organization and Mr. Verity's first associate in the working out of the practical problems involved in the new venture.

Robert B. Carnahan, Jr.

He was introduced to the new organization through First Vice-President W. T. Simpson, who had known him for many years.

Mr. Carnahan contributed so much to the early struggles of the then infant industry that was destined to become a giant, that no history of its first twenty years could be written without giving him a very special place in it. This

in spite of the fact that nowhere else in this history is any other man who had to do with its early upbuilding so described.

Steel making by the open hearth process was new in 1900, as was evidenced by the fact that several of the largest steel companies were then experimenting with it. Men who had practical experience were scarce.

Mr. Carnahan secured his early training with the W. De Wees Wood Co. and the Carnegie Steel Co., both of Pittsburgh.

A metallurgist and scientist by nature and training and an indefatigable digger by habit, he assumed the task of designing, construction and operation of Armco's first open hearth furnace with the eagerness of a youth starting out on his first great adventure in life.

He actually lived with that furnace and its successor during the first five years of the company's history. During that period the foundation for the Armco of today was laid.

It was under his personal supervision that the company's commercially pure iron was developed, patents on the process and product secured, and the first large tonnages produced.

He was first Superintendent of Open Hearth Department, then General Superintendent of Works, and finally Vice-President in Charge of Research and Development Work and Patent Interests.

He was known and respected for his many unusual sterling characteristics. He was loved by all because of his great generous nature and his kindly and considerate attitude towards all.

Robert Brown Carnahan, Jr., was a man of magnetic personality, of unusual metallurgical attainments, and of remarkable ability, perseverance and endurance. His memory will live forever in the hearts of Armco men.

Chapter XXXII

Company Policies as Approved by Directors

Report of President to Board of Directors, Dec. 12, 1919—Trying New Ideals in Business—Critical Analysis of ARMCO Policies—Adoption and Operation of New Policies.

To the Board of Directors:—

THERE are some resolutions that are never written, some reports made not recorded, in order to avoid the establishment of precedents or the unnecessary assumption of responsibility.

I have reduced my version of Armco policies to writing so that I can more clearly visualize them to you, and with the further definite intention of thereby making of them a record that must stand or fall on their strength or weakness, on their soundness or impracticability, both now and throughout the future history of our company.

In the early days of this enterprise, policies were established, based on our understanding of and belief in certain fixed principles, which, as time has gone on, have been amplified and broadened in their application, but have never been changed.

We must confess that we have incorporated in these policies some ideals that may not have been tried before in a business of this character, but it has always been our constant endeavor to keep well within the practical in the working out of our plans.

We have from period to period endeavored to secure and hold your support of heretofore untried policies long enough to give us opportunity to prove their value and to secure such a demonstration as would enable us to so fully analyze each proposition that you could pass intelligent judgment upon it.

We were, unquestionably, pioneering in the adoption of certain policies having to do with development of organization and the creation of such conditions as we felt would make for real civic and industrial stability.

Many things in which we have believed have, in the progress of the times, been applied by other companies in

OFFICERS AND DIRECTORS

1 · 9 · 2 · 1


J. H. FRANTZ
Vice President


G. M. VERITY
President


R. C. PHILLIPS
Secretary


C. W. VERITY
Treasurer


C. R. HOOK
Vice Pres. and Gen. Mgr.


W. S. HORNER
Director


F. H. SIMPSON
Director


J. M. ISEMINGER
Director


P. STURTEVANT
Director


J. M. HUTTON
Director


J. P. ORR
Director


G. BATTELLE
Director


S. M. GOODMAN
Director

a much larger way than we have felt justified in doing. It has been our policy to do as many things as we considered sound, expedient, and psychological in the creation of that condition of individual happiness and of mutual confidence between the management and all those engaged in its service, but in a reasonable and moderate degree, instead of doing any one thing on a large or expensive scale. We have found that no one plan or proposition will reach every one but that one thing may appeal to one group and something else to another. It is the combination of all of the mutual interest things that we have done that has made life in Middletown and in Armco service worth while.

We realize that had we talked of "Policies Built on a Platform of Christian Principles" some fifteen or more years ago, that we might have been granted a much needed rest in some nearby sanitarium. Today, after twenty years of practical application, we stand ready to openly defend that theory and intent, which has been our definite purpose from the beginning.

If we have demonstrated in any reasonable measure that the incorporation of high ideals and the application of Christian principles in the conduct of industry can be made to pay, we may all feel abundantly rewarded for our contribution to such a cause.

With these years of history behind us, we are glad to assume the responsibility of architect and designer and we are happy to have had some part in the building of this Armco structure, or rather of the foundation thereof, for we feel that as yet only the foundation has been completed.

We now court your critical analysis of the sum of Armco policies and accomplishments to date, and, if we are to be entrusted with the responsibility of beginning the building of a real superstructure, we will be guided by the result of such an analysis.

Beginning in 1900 with only three active directors, our board has grown to its present proportions. Three valued associates have been removed by death, and one resigned after several years of service. As time has gone on, we have come to realize that there has been much of history that has important bearing on both past accomplishment and future success that is not known or fully understood by even some of our oldest directors, as each one has come into our circle at different periods, and time and opportunity have not made it possible to fully inform them.

Again, the current events of each period have of themselves been sufficient to absorb the thought and interest of the board as it has been constituted from time to time.

It is, therefore, our desire to take this opportunity to explain as clearly as possible just what are the policies that have been adopted and practiced and what has influenced us in bringing them into life. It has always been our belief that one cannot fully or properly judge an act or a policy without understanding just what is back of it, what is the real intent or purpose that influenced it. With your consent, we will also go over with you from time to time such periods of history as cover the practical and metallurgical developments that make Armco what it is. The possibilities of the future must be judged as much by the accomplishments of the past as by what we have and are today.

The American Rolling Mill Company was organized to provide a high-class permanently profitable investment through the manufacture of such special grades of iron and steel as would be required in the fabrication of high-grade finished products.

To secure such a result in the largest measure, its organizers believed that it would be necessary to adopt and to practice such policies as would bring about a condition of mutual confidence and create a spirit of sympathy and of real cooperation between the members of its working organization, its customers, its stockholders, and the citizens of the communities in which its plants would be located. They are:

1—To do business guided and governed by the highest standards known to the business world.

2—To strive for that sort of "reputation" in all things as will make "reputation" an invaluable asset.

3—To provide the best equipment obtainable suitable to the particular needs of our business, both from the standpoint of economy in maintenance and operation, and in efficient performance, and to apply to it a high standard of maintenance, the cost of same to be absorbed in each year's operations.

4—To build up and maintain a high grade, efficient, loyal, ambitious, aggressive and successful working organization who thoroughly believe in their company, to whom

work is a pleasure and extraordinary accomplishment an all-consuming ambition.

5—A working slogan of "Quality and Service," representing Quality in plant property and equipment in organization and in product, and Service to stockholders, customers and to our city, state and nation.

To develop the highest possible quality of product suited to the need of exacting manufacturers of quality articles, so as to make our company, its products and its service indispensable to them, thereby creating commercial stability and assuring steady growth.

6—To never be satisfied with anything less than the best results possible of attainment in each and every proposition or problem to be solved.

7—Believing in the principle and theory that one cannot serve two masters satisfactorily or successfully, employees holding important positions with the company should not become financially interested in any company with whom The American Rolling Mill Company does business either in buying or selling.

8—To be CONSISTENT in the application of our policies to *each* and *every situation*. To accord to *each* and *every individual* connected with the company *such degree of consideration* and *firmness* as their individuality requires and the situation being dealt with demands in a proper conduct of the business.

9—To create a working partnership and a real spirit of cooperation between the community and industry, to the end that community conditions might, as a whole, respond to the highest needs of that type of stable, sober, industrious, efficient, thrifty, and ambitious man that we felt was necessary to make a real success of our high grade and complex industry. This policy has been born of our belief that anything and everything that makes for better civic, moral, physical, social, and educational conditions, anything that is helpful to the community as a whole, is of the most vital interest to us and deserves our largest personal sympathy, and our most liberal personal and corporate support.

10—To create through the adoption and operation of these policies such a condition of mutual confidence, such a strong bond of mutual interest and of loyalty between Armco, its organization, its customers, its stockholders

and the communities in which its plants are located as will make for permanence, progress and profit.

11—To recognize in proportion to our prosperity, our obligations to the state and nation, who make possible the conditions under which we exist and operate, as well as those to society at large, in the belief that every right-minded, sound-hearted individual or group of individuals should contribute, in proportion to his or their ability, to world progress and to the advancement of all those things that make for human opportunity, development and ultimate happiness, and in the further belief that it is the responsibility of every institution to help as far as it can to keep *moral progress* apace with *material progress* as a matter of national safety.

12—To develop and to encourage Americanism and a real live spirit of patriotism, within and without our organization.

13—In the treatment of customers, to be fair always, to never exact "the pound of flesh," to be considerate, to make our promises as to quality, delivery and service so conservative that we can, on the average, give more than was agreed, an unexpected dividend—so to speak—on each transaction, and to make courtesy and service an outstanding Armco feature.

14—To consider in all things that make for success or failure—What is the best interest of the business as a whole, the joint interest of all.

15—To build up financial connections in advance of their need, and to always keep them fully informed as to the progress of the business.

In attempting to visualize this important group of policies, we cannot do better than to simply incorporate what was said on that subject at our last annual meeting of "Special Partners," salaried men, held in Armco Hall on November 28, 1919.

"There are four factors essential to the promotion, life, and progress of industry. They are:

1. Capital.
2. Plant and Equipment.
3. Organization and Plant Spirit.
4. Customers.

"The first, second, and fourth factors mentioned are absolutely essential; and often try to the limit the fibre

and the souls of the men who are back of an enterprise before they can be brought together in proper quantity, quality, and relation each to the other. Many a project fails before it ever reaches this point. However, with that goal reached and seemingly well-fortified, any enterprise can and will fail without the third essential, which is a thorough, sound, and efficient organization and plant spirit—a blending of those seen and unseen forces in every institution which are only productive when safely guided by trained human hands and hearts.

"In these days of rapid evolution, it has been claimed that what is commonly called 'Labor' is responsible for all the wealth created.

"One has only to study the history of the world down to the present day to see clearly the fallacy of such a theory. Labor is just as essential as capital, equipment, and customers. But, all such essentials will utterly fail and in due course disappear unless there is provided some directing force that can plan and execute intelligently. The massing of all the labor in the state on any given job could not make for profitable production or add to the wealth of the world unless such labor was engaged in carrying out some carefully made plan which made it possible to dispose of the product of this labor for a sum greater than the aggregate cost of labor, materials, and interest on the capital engaged. And even then 'tis said:

" 'The best laid schemes o' mice an' men gang aft agley.'

"It is organized effort that makes for accomplishment. It is, therefore, the task and the responsibility of every management to create a live, loyal, and potent organization.

"From its very inception, Armco has pinned its faith to men. It has admitted and insisted that it must stand or fall in proportion to its ability to gather around it a group of able, earnest, loyal, and thoroughly trained men sufficient in number to meet the need of each succeeding period, and bound together by the strong and enduring ties of 'Mutual Interest.'

"Kipling must have been talking of effective organization when he said:

" 'Interdependence, absolute, foreseen, ordained, decreed!
To work ye'l note at any tilt an' every rate of speed.'

"To attain this harmonious and flexible interdependence of the innumerable factors entering into a manufacturing business, there must be that sort of organization which spells 'Cooperation.'

"In general, Armco has attempted to create a compact, adhesive organization by bringing into existence *a condition of thorough understanding and mutual confidence* between all individuals engaged in its service.

"The following are the main planks in the platform on which Armco organization has been constructed:

1. A square deal always and to every one.
2. Fair and, as far as possible, generous compensation for service rendered.
3. Good living conditions.
4. Good working conditions.
5. Opportunity for advancement.
6. Cooperative management, such as is now more fully visualized by our General Advisory Committee.
7. Every possible and practically sound *incentive.*
8. Creation of the best possible *environment* in which to live and work.
9. 'Mutual Interest' activities and performance.
10. Creation and development of *Armco Spirit.*

"Let us discuss these planks seriatim:

"1. *A Square Deal*—There are two kinds of square deal. The Armco kind is that sort which is born of the belief in doing right for the sake of right, and not just because it might insure results. The other kind is born of a selfish purpose, and this 'Square Deal' is simply used like cold steel—as an implement of accomplishment. It is the body without the spirit—the man without the heart—and, in our opinion, it cannot be permanently effective.

"2. *Compensation*—It is Armco's wage policy to pay for every class of service a standard of compensation as high as is current in competitive industries.

"It is Armco's ambition to develop an organization of such spirit, loyalty, and efficiency that it will be possible for individual members to earn and receive better compensation than if performing a similar service in other fields of effort.

"3. *Good Living Conditions*—Armco believes that good living conditions, in both home and community, are

essential to the highest individual efficiency; that happiness, for which man is struggling, cannot be attained without good living conditions.

"4. *Good Working Conditions*—Armco believes that good working conditions, in the fullest sense of the expression, are absolutely essential to industrial efficiency and progress.

"5. *Opportunity for Advancement*—is the ladder on which the individual hopes to reach his ultimate goal—his heart's ambition. Without such a ladder, there can be no such hope, and without hope, life is a failure.

"6. *Cooperative Management*—is sound because cooperation is the medium through which great accomplishments may be attained. Success, ultimate and complete success, depends more on the spirit of helpful cooperation that exists in an organization than on any other one factor.

"7. *Incentive*—This is the great mainspring of accomplishment. Life, as organized, has many incentives that urge us on to do our best in our chosen field of effort. The average individual must work or starve—life was so ordained. This is real incentive. Loved ones dependent on us for care, protection, and education are one of the greatest incentives which come to a normal man. Organized industry, however, can add other real incentives which will make for increased efficiency and more rapid progress. Armco believes in the development and the application of every possible sound incentive. Special compensation to those who are carrying real responsibility in the management of the company's business, represents one of the *practical incentives* inaugurated in Armco organization.

"8. *Environment*—Armco believes that, individually and collectively, we are the product of the environment in which we live and work—that IDEALS make for accomplishment and advancement, and that IDEALS thrive in good environment. We believe that the influence of God's own handiwork, as expressed in green grass, trees, and flowers, is one of the great factors in favorable environment. We believe that cleanly, orderly approaches and mill yards help to make us walk straighter, think clearer, and feel finer than do the opposite. We stand for the best environment that can possibly be created

in the community at large, in and around our homes, as well as on the battle field of our daily labor.

"9. *Mutual Interest* is the 'manganese' that binds a group of men and women together in every sort of effort. Without 'Mutual Interest' there can be no serious application, no real loyalty, no cordial cooperation, and little chance for concerted and effective effort.

"When a group of men have an outstanding 'Mutual Interest' in their daily toil, it takes out all the disagreeable features and makes work a pleasure. It makes for maximum effort and accomplishment, and it makes for satisfaction—whatever the measure of reward. 'Mutual Interest' is the real foundation on which Armco is building its working organization, and we believe 'Mutual Interest' will likewise control the size and character of Armco's ultimate superstructure of commercial success.

"10. *Armco Spirit* has become so engrained in the lives of Armco men and women and so much a part of their every activity, that it needs no introduction or explanation to Armco men. The unseen, intangible powers of nature which have been controlled and used by man, are unquestionably among the greatest influences which we have available for use today in our human exploitations and with which we have to contend in human affairs. What we call 'Spirit', as applied to human activity, is one of those mighty unseen influences that make for victory, both in the tragedy of war and in the pursuits of peace. Without a real group of community spirit in commercial and industrial organization, cooperative effort would lack both the *pride* and the *power* of accomplishment.

"ARMCO SPIRIT makes for Pep, Pride, Production, Progress, Patriotism, and Prosperity.

ARMCO SPIRIT

" 'ARMCO SPIRIT' is a comprehensive vital force which finds expression in the practical application of policies builded on a platform of Christian principles, in which selfish purpose has no place.

" 'ARMCO SPIRIT' combines in proper proportion a spirit of fairness, a square deal always, both in theory and practice; a big broad view of every problem, cutting out all narrowness and littleness; a spirit of unselfishness, of loyalty, of courtesy to and consideration for the other fellow.

" 'ARMCO SPIRIT' is, in fact, simply an exemplification of the highest standard of real American citizenship.' "

In conclusion there are several policies which I wish to explain more fully. The work of our mutual interest and personal relations department was explained to you in detail last spring, giving you a very clear idea of its ramifications and its cost. This work all comes within our policies as affecting organization. It is our belief that in this work we are securing a larger and sounder result, and at a very considerable less cost, than has been secured in some other places where somewhat similar things have been done. In these things, as in all mutual interest work, we only aim to share the financial burden with the organization as was done in the Zanesville Armco permanent home proposition and the Armco war fund. Through the medium of this work and the association that it brings, we have aimed to secure such a clear understanding by each side of its own attitude and of the problems of the other, and of our joint recognition of our relation to society at large, as will result in the substitution of responsibility for irresponsibility, of cooperation for antagonism, and of good will for suspicion and distrust.

Our mutual interest and social workers have scrupulously avoided all aspect of social uplift, of philanthropy, or of meddlesome intrusion into home life or private affairs. They have, on the other hand, slipped quietly into the homes and lives of our people in time of trouble and have endeavored to make themselves useful and necessary.

The planting of grass, trees, shrubbery, and flowers, the building of walks, the parking of spaces around the bank, the hospital, general offices, and plant entrances have all been a part of our scheme to create a good environment. Every single thing done along this line has been a part of a definite plan. We feel that the effect of our effort along this line has gone beyond the confines of our offices and works into the homes of our people. If you could have seen the conditions surrounding the average home in Middletown twenty years ago as compared to what they are today, you would fully understand what marked advancement has taken place in community environment. We believe that our investment in everything that has encouraged and made directly for *environment* will be paying dividends long after some of us have gone on to find a new environment in the Great Unknown.

We believe that national industrial stability or instability simply reflects the sum of the average conditions that exist in individual communities.

Second, that conditions which make for human unrest and unhappiness must be remedied largely by each community for itself.

Third, that industrial stability is influenced very greatly by civic conditions.

Fourth, that industry should support every constructive agency in the community and help to make it as strong and as much of an influence for good as possible.

In all of these things, Armco has said to Middletown —"You do your best to make civic conditions respond to the highest needs of your citizenship and support every proper thing that will make for civic and industrial stability and progress, and we will work with you unceasingly and bear our full share of every burden."

We are not unmindful, neither do we lack appreciation of the support that our board of directors has given us through the years that have passed, covering these various policies, when it was impossible at the time to judge as to their soundness or their practicability. That is the reason that we now wish to give you an opportunity to review them as a whole and to have such further analysis or justification as you may desire.

In conclusion, I wish to assure you that from its very inception, it has been a consuming ambition of your Armco management, in its dealings with everyone, to find—

THE WAY CALLED STRAIGHT

To seek above all gifts of earth or heaven
The Truth of things; and in the quest to lend
An open mind whose patient gentleness
Blurs not the picture by quick inference,
But gives to every soul its legal right,
The fighting chance to bring before the House
Its point of view, and thus the motive show
In all its richness or its poverty,—
Deep underlying force of every act—
And in the Silence that enwraps the soul
Of each and every seeker after Truth
To scan with Clearer vision all the facts,
And with conviction finally to judge,
As judged the Christ, unbiased by one thought
Of gain for Self—This is the Way called Straight,
Who enters there shall find the Holy Grail.

—*E. S. C.*

GEORGE M. VERITY,
President.

December 12, 1919.

Addenda

THE first twenty years of Armco History has been faithfully recorded, but so swiftly does time marshal events that during the compilation of this history, immediately following the close of the twenty year period, the American Rolling Mill Company made another important step in its march of progress by acquiring the property and assets of the Ashland Iron & Mining Company, of Ashland, Ky.

On December 31, 1921, a consolidation of these new interests under the name of the "Ashland Division" of The American Rolling Mill Company, added to the already extensive manufacturing facilities of Armco a new property which, properly and fully developed, will unquestionably prove to be of very great value.

The manufacturing plants at Ashland comprise two blast furnaces, six open hearth furnaces, a modern electrically driven blooming mill, a slab, billet, and bar mill and six sheet mills.

The Ashland properties which were taken over also included the Ashland Coal and Iron Railway Company, which operates 48 miles of track, with necessary rolling stock and motive power. Of this trackage some 21 miles are used as a part of the main line of the C. & O. Railway. The holdings embrace all the stock of the Inter Terminal Transit Company of Ashland, which handles a large proportion of the industrial switching in that city.

Twenty-two thousand acres of coal and timber and natural gas lands adjacent to the properties, from which they are drawing their fuel supply, were also included in the new purchase.

The material value of this property is very greatly enhanced by the spirit of the citizens of Ashland toward Armco. On February 16, 1922, the Chamber of Commerce of Ashland entertained the executives of the American Rolling Mill Company at a dinner and pledged enthusiastic individual and civic support to the principles, policies and problems of Armco.

The Ashland Division of The American Rolling Mill Company has a bright future before it. The works of the company are ideally located along the bank of the Ohio river, which gives an opportunity to take full advantage of water shipments in the transportation of raw material and finished products. From three to four miles of valuable river front property gives ample room for growth and development.

The acquisition of the Ashland Division brings to The American Rolling Mill Company added power and prestige in the steel and iron business and marks the creation of a complete new industrial unit that should largely increase its earning capacity. Armco crosses the threshold of its second twenty year period with more than fifty-five millions of total assets.